

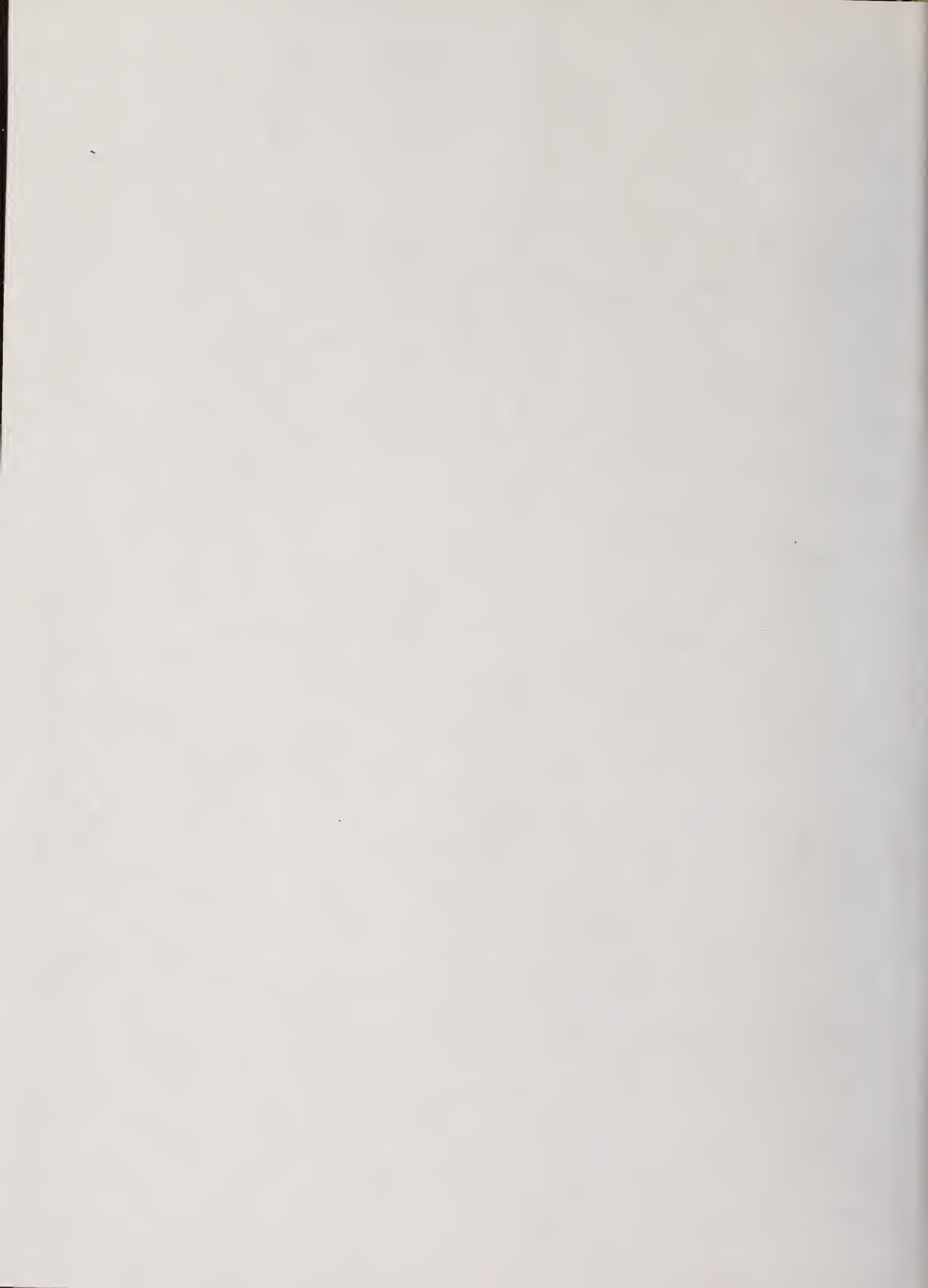


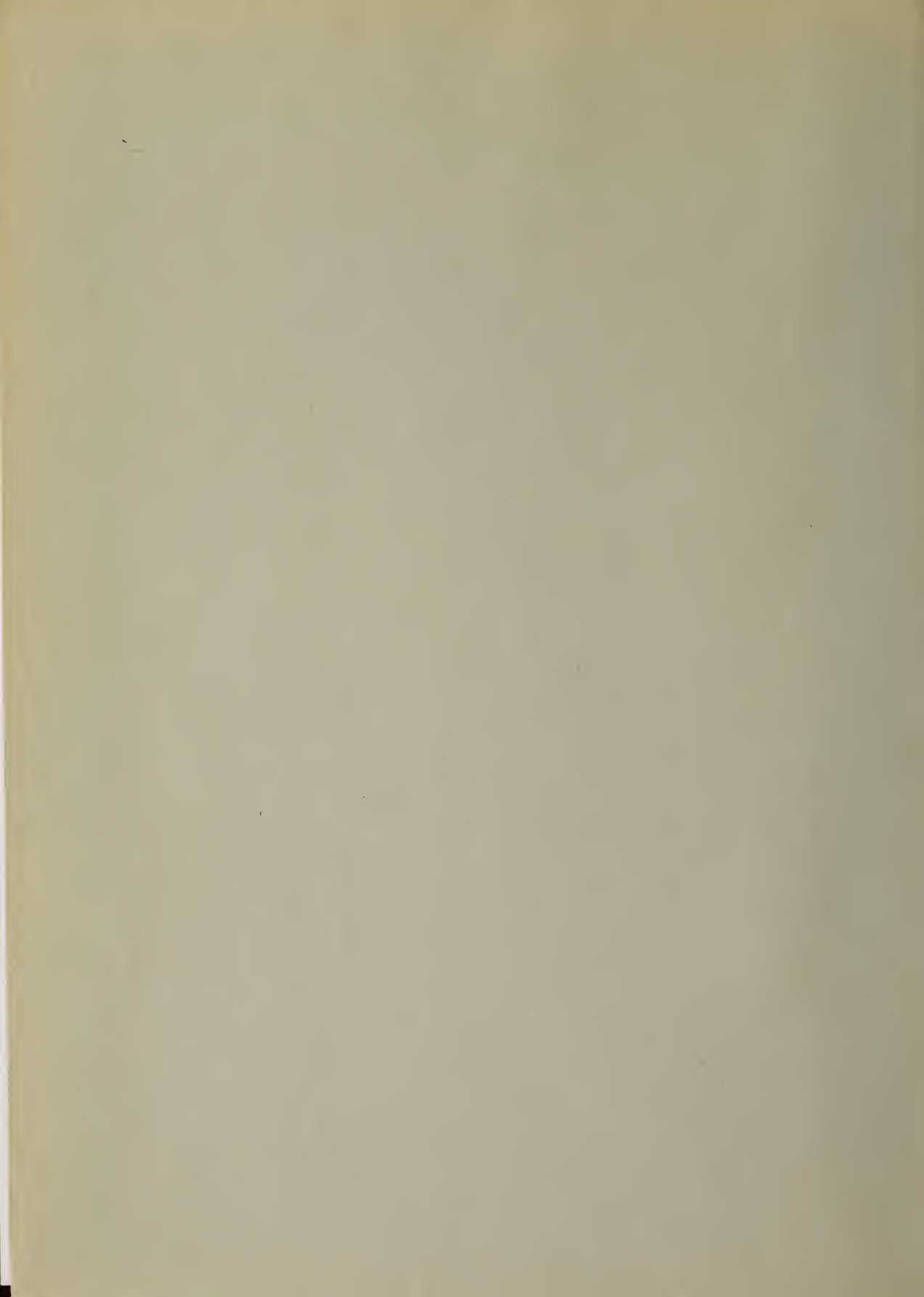
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BRITISH KINEMATOGRAPHY

Volume 18, No. 1

January, 1951

In this issue:

MOTION PICTURE PRESENTATION

by S. B. Swingler, A.I.E.E., M.B.K.S., and
R. R. E. Pulman, F.B.K.S.

TECHNICAL OBJECTIVES IN
PRE-PLANNING PRODUCTION

by K. E. Harris, M.B.K.S.

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BRITISH KINEMATOGRAPHY

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THE NEW FORMAT

A TECHNICAL Journal is one of the most valuable assets that a scientific society can possess. Not only does it keep the members informed of what is going on in other branches of their Society, but in many cases it is the only permanent record of original material presented at the meetings and discussions. As Professor Kapp has said: "The status of a scientific body is judged by the standards of its publications."

For this reason the Journal Committee has spent a great deal of time during the past year in discussing how best to improve BRITISH KINEMATOGRAPHY both in contents and style, so that it can claim to be truly representative of British cinematograph technique.

One of the suggestions which has been put into effect is the altered format in which this issue appears. The increase in page area will enable better reproductions to be made, and the readability of the text matter has been improved by the change in column width.

A brighter appearance of the contents is matched by a brighter cover, which has been specially designed for the Society.

Your Committee will use their best efforts to see that the technical standard of BRITISH KINEMATOGRAPHY is maintained, and is confident that the changes will meet with the approval of all members.

H. S. HIND,

Chairman of Journal Sub-committee.

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Hon. Consulting Editor: GEOFFREY PARR, M.I.E.E. F.B.K.S.

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MOTION PICTURE PRESENTATION

S. B. Swingler, A.I.E.E. (Member)* and R. R. E. Pulman (Fellow)*

Read to a meeting of the British Kinematograph Society on November 1, 1950

THE subject of motion picture presentation is by no means a simple matter of good picture quality and sound reproduction alone, but goes much deeper than that, involving other important factors such as patron comfort and emotional stimulation.

Entertainment is a business, and can be defined as "To receive and treat hospitably, to hold the attention of and to amuse." Comfort, consideration and courtesy for the customer should be the primary aims. It is believed that it can be fairly stated that in no other business premises in the world is the customer given more consideration than in the properly operated motion picture theatre.

Nevertheless, we rely entirely upon repeat orders, for the customer purchases the product upon our guarantee of quality and satisfaction, and furthermore he pays for the product before he sees it. The task is ours to present motion pictures to the public in such a manner as to assure those repeat orders for which we strive so mightily.

The exhibitor is entrusted with the task of selling the product, and the box offices see the ebb and flow of the money that will finance the future.

Technical Aspects of Presentation

Many thousands of pounds are spent annually on presentation of motion pictures in the kinemas of this country, and the vast facilities of the electronic, electrical, mechanical, optical, and other fields, together with the latest developments in furnishing, acoustic and thermal materials, are utilised to the one aim of furthering the enjoyment and comfort of the patron. Only a perfectly co-ordinated combination of high quality projection and sound reproduction, ample comfort and calculated emotional stimulation will assure patron

enjoyment in full measure and thereby complete satisfaction.

Successful presentation of a motion picture entails painstaking attention to a multiplicity of small details, each of which, if neglected, can detract from the final result. On the other hand, due attention to each of these details will be rewarded by the excellence of that final result. We are concerned here only with the engineering aspects of motion picture presentation, but attention to detail is as necessary right through the wide field of kinema theatre operation.

Obsolescent Equipment

Let it be admitted right away that there are many kinemas in this country using equipment that is simply not capable of producing results commensurate with the desirable standards now recognised. The most conscientious projectionist cannot get out of any equipment more than its capabilities allow or, for that matter, get more out of a release print than it contains.

In the course of time and through force of circumstance, all kinema theatres will be brought up to standard, and this in itself will allow the present British Standards to be tightened up, for, rightly, they cater for wide variations at the moment.

To achieve successful motion picture presentation in the fullest sense of the word, projection and sound reproduction must be as nearly perfect as the skill and wit of man can devise. Lighting, both decorative and advertising, must be attractive and stimulating, and, at the focal point of the auditorium, used to create pleasure and vitality. Heating and ventilation must cater adequately for patron comfort through warmth and the movement of air without draughts. Carpets and decorations must convey a sense of luxury, seating must give

* Circuits Management Association, Ltd.

comfort over long periods of time. Cleanliness must make itself felt, and in fact, everything must be focused on the provision of satisfying entertainment and comfortable relaxation for the patron.

Structural Costs

It is not the purpose of this paper to examine in detail the technical complexities, but rather the broader aspects, and in this connection it might be interesting to give some indication of the costs of certain items embodied in the kinema which contribute very largely to "patron comfort." These figures are percentages based on the total cost of an average kinema built, equipped and furnished prior to the war, excluding the cost of the site.

Naturally these percentages vary in accordance with the type of building and the degree of "patron comfort" desired, but the following figures may be taken as an average for a typical kinema built between 1932-1939:

Projection and Sound	4.0%
Electrical Installation	5.1%
Heating and Ventilation	6.3%
Furnishings, Seating, Carpets	9.0%
Decorations, Fibrous Plaster, and Acoustic Materials	5.6%

In the main, no new kinemas have been built over the last ten years and so observations are naturally confined to what may be termed "present day techniques" and methods of operation. Behind the scene, developments and planning have been carried out unceasingly and one cannot foretell the surprises in store for the kinema patrons of the future.

Some members of this Society were able to hear Dr. Wells Coates present a paper on "Planning the Festival of Britain Kinema," and were privileged to get a glimpse of the possibilities of developments in the future. Nothing can remain static, we must always progress, and while the future must necessarily be shrouded in mystery, it holds considerable promise in our part of the entertainment industry.

I. PICTURE PROJECTION

High standards of projection and sound reproduction must be given first considera-

tion. Accurate determination of the suitability of grades of equipment for particular auditoria has a distinct bearing on the ultimate results.

The fundamental requirements for good projection have been discussed elsewhere, but from the patron's point of view these may be stated as:

1. Clear vision of the entire picture area from every seat.
2. Skilful and unobtrusive operation of the equipment.
3. Adequate screen illumination and brightness.
4. Suitably arranged surroundings to the picture area.

Viewing Conditions

The first item, that of clear vision, is somewhat elementary and more a matter of careful planning than anything else; but it is the first fundamental step in good motion picture presentation. No patron can enjoy viewing a picture area, part of which is obscured by the head, if not the shoulders, of another person seated within the visual angle subtended by the picture.

Good viewing conditions demand compliance with the Eyestrain Regulations in the relationship of picture size to seating layout. Distortion, both in viewing angles and in projection angles, must be kept to an absolute minimum.

The Skill of the Projectionist

The second item, that of operational perfection, is of paramount importance and calls for the full use of the projectionist's skill and sense of showmanship in presentation. It lies within the power of every projectionist to add to or detract from the final result, into which the brains and experience of a band of technical and artistic experts in every phase of film production have merged to produce what might well be the finest scenic and artistic presentation in the motion picture field.

So much effort is put into the making of a motion picture that final interpretation cannot be ignored. Here the skill of the projectionist makes itself felt, for in many ways he can help to turn what might be a

passable motion picture into entertainment value.

Consistency of screen illumination is perhaps the most important item under the direct control of the projectionist. Screen illumination that flickers, is unsteady or shows signs of uneven colour—the “blue” or “brown” corners that result from incorrect arc focusing or maladjustment of the optical system—reminds the patron of the illusory nature of the entertainment being offered and spoils his enjoyment accordingly.

Proper distribution of the light intensity across the screen is another factor under the control of the projectionist, and one which, when properly adjusted, adds its own contribution to perfection in presentation.

Picture focus is another item that demands constant attention. Sharply focused detail gives good clarity but necessitates some delicacy in adjustment. Picture focusing by the over enthusiastic sometimes gives rise to a slight feeling of sea-sickness among the viewers.

A keen sense of timing on the part of the projectionist is part of showmanship in presentation, and gives a polish to the finished product. Careful and split-second timing of screen tabs against titles and ends, of main tabs, of house lighting, all add lustre to the general effect.

Projector and Film Care

Modern motion picture projectors give a picture image that is amazingly steady considering the large linear magnification of the tiny film frame, and it is only when the projector needs repair, adjustment or replacement of worn parts that picture unsteadiness becomes detectable to other than the trained observer. Transient movements caused by joins or poor print condition are generally not observed by the audience, but any permanent weave or jump should be corrected at once.

Coupled with this question of operation of the equipment is the need for proper handling of the film stock. Scratches, “rope marks,” damaged perforations, and poor joins all tend to remind the patron of

the mechanical nature of the entertainment, and can utterly spoil outstanding photography and sound recording.

Change-overs are a potential source of programme discontinuity. They should be invisible and inaudible, and except to the habitual dot watcher they should pass undetected. There is no excuse for a poor change-over, even when the print is in poor condition, lacks standard change-over dots, and is probably mutilated by the trade-marks of incompetents. Unless there is definite discontinuity or badly cut dialogue, the patrons will not notice a good change-over, and good change-overs are the hall marks of good projectionists.

Screen Illumination

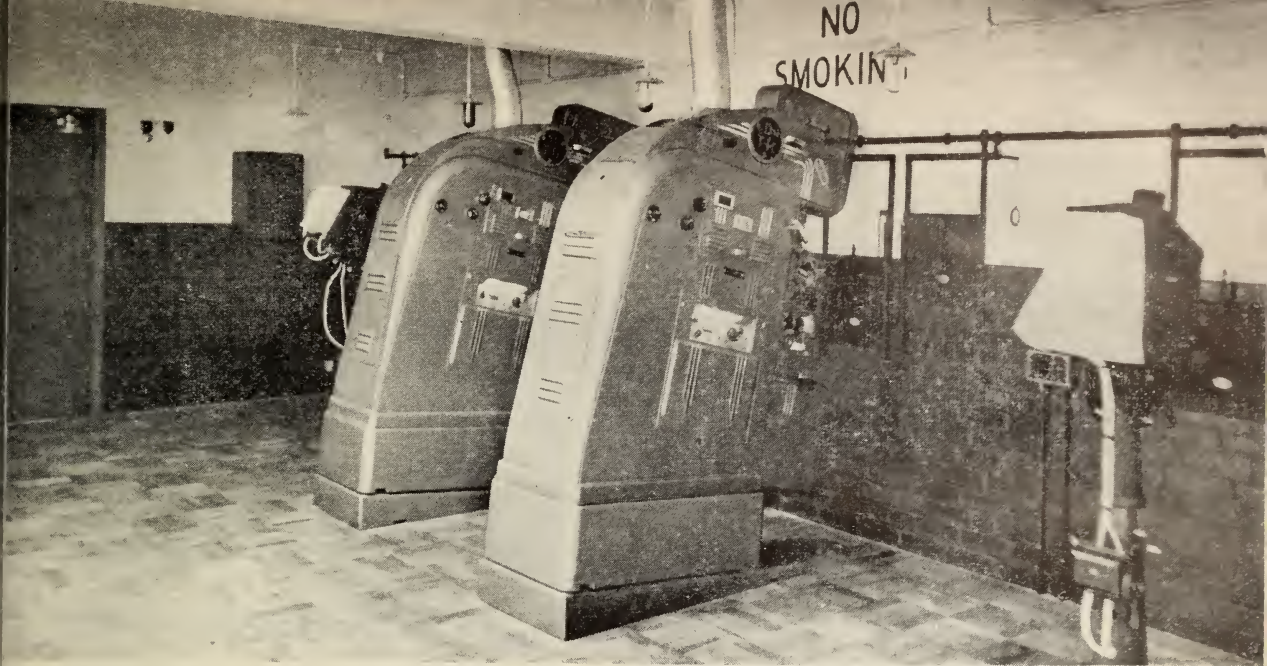
The third item, that of adequate screen illumination and brightness, depends upon the total light output available from the motion picture projectors and is, therefore, not generally under the control of the projectionist, except when it is less than normal owing to maladjustment of the equipment.

Much has been written on the subjects of screen illumination and screen brightness, and it is readily available for reference; it will suffice here to recommend that screen brightness should lie near the upper limit laid down in the British Standard No. 1404. This recommendation will assure “sparkling” picture quality and help both the film production technician and the laboratory technician in their efforts to give our patrons maximum clarity, contrast and beauty in photography.

It should be noted that to exceed the B.S.I. recommendation is less desirable than to be below the minimum, for it results in washing out certain prints and produces scintillation and flicker which cause visual discomfort.

The Screen

Screen surfaces are designed to suit different shapes and dimensions of auditoria, and a pre-requisite of good presentation lies in the correct choice of a suitable surface and its maintenance in good condition. A



A Typical Modern Projection Room.

compromise must be made between the maintenance of reflective characteristics and sound transmission characteristics. The greatest difficulty in maintaining reflective characteristics is caused by tar contamination due to patrons smoking in the auditorium. A proper system of regular resurfacing or replacement is necessary to prevent the reflection factor dropping too low and to correct the inevitable spectral shift. Each situation needs to be considered separately, account being taken of the type of ventilation plant and the inherent cleanliness of the locality.

Patrons look at the screen for long periods of time, yet the screen itself should be invisible to them. Any uneven deterioration will show up distinctly on highlights and pan shots, drawing the patron's attention forcibly to the screen itself as opposed to the picture image which they see normally.

Screen Surround

The fourth item, that of screen surroundings, is important if only because these surroundings are always within the visual field of the patron and when properly arranged help considerably to maintain the required atmosphere,

Whatever the form of surround or masking to the picture, symmetry is important, as the surround or masking is within the most sensitive part of the visual field and so, if masking lines are crooked, ragged or bowed, a sub-conscious irritation is set up which spoils the enjoyment. Too large an overlap of the projected image, uncorrected keystone distortion, and picture re-reflection from dusty masking, are other small items that tend to mar the ultimate result.

The apparent size of the picture image from different parts of the auditorium is another factor that must be considered. There is no enjoyment in looking at a postage-stamp from the rear of the auditorium, or for that matter in experiencing a stiff neck from gazing upward at an acute angle at a huge picture from the front of the auditorium. Experience, technical knowledge, and common sense can do wonders in providing an apparent picture size suitable for all parts of the auditorium. Draping of the proscenium has a great effect upon apparent picture size; a large proscenium opening draped with dark borders and legs will make even the largest picture look small by comparison. Intelligent draping designed from the picture viewing aspect is well worth careful study.

Visual Distractions

One of the most annoying factors to patrons is distraction from the focal point of the auditorium through various reasons such as re-reflection of the picture from a specular surface, which may be a lighting fitting, a brass rail, some glossy paint work, an organ cover or many other items. The stage floor should always be covered with a matt surface which will not reflect the picture, and it is sometimes convenient to use material that will be advantageous acoustically. Light screen curtains of specular material which lend themselves to very pleasing lighting effects sometimes add to picture re-reflection, but can generally be arranged so that they are drawn off behind non-reflecting legs during presentation of the films.

Discomfort glare which reacts unfavourably on good picture viewing conditions and degrades contrast is often to be found in cinema auditoria. These glare spots are most annoying and should be eliminated. Most common offenders are relatively brightly lit clocks, exit signs, maintained lighting fittings, entrance doors allowing shafts of sunshine into the auditorium, light from the portholes of the projection room, or even an usherette's torch.

2. SOUND REPRODUCTION

Sound reproduction should be such that speech is natural, vocal and instrumental music is perfect in tonal balance throughout the full frequency range, and dramatic effects, from the merest whisper to the thunderous roar of an earthquake, faithfully and intelligibly portrayed. Sound reproduction must also be perfectly synchronised with the movements of the screen image.

Requirements for successful sound reproduction in any cinema theatre auditorium are:

1. High quality sound reproduction heard without effort in every seat.
2. Intelligent operation of the sound reproducer equipment.
3. Good auditorium acoustical conditions.
4. Well recorded sound film tracks.

5. Well recorded and well maintained gramophone discs.

Salient points to watch on sound reproduction are intelligibility, distribution, and volume level.

Sound Volume

Basic volume level is of great importance and is affected by the locality of the cinema. If the locality be one where there is a predominance of noisy heavy industry then the basic volume level will be higher than in an agricultural area. Basic volume level should be adjusted so that listening in the rear stalls and rear circle is normal and effortless, and related to the number of persons in the auditorium at different times during the day.

In some auditoria, unnatural speech and harsh tonal quality are heard through excessive use of the available power output of the sound reproducer, which power output is always rated higher than the requirement for maximum volume for the particular auditorium. This excessive use of the power output causes distortion and acoustic break-up, with accompanying irritation to the members of the audience.

Another source of annoyance to patrons is extraneous noise, such as that emanating from passing traffic, noisy doors, curtain runners, etc., and every effort should be made to eliminate such sources of petty annoyance.

A possible source of unsatisfactory sound in an auditorium is the positioning of the speaker assembly. This is set to give maximum overall quality, distribution, and illusion, and where speaker rostrums are mobile or the assembly can be flown, any movement out of normal position will seriously affect these points.

To assure the maintenance of maximum results from the sound reproducer, quality must be constantly checked. Like other equipment there can be a gradual deterioration that is so slow as to defy detection. The degree of deterioration over a period of time may be considerable, although undetected, if there is no means of comparison,

Interval Music

An essential part of the presentation is the reproduction of gramophone discs, and considerable attention has been given to the design of the non-synchronous attachment to the main sound reproducer with the object of assuring the very finest sound reproduction from discs. Fidelity cannot be obtained, however, from discs that are badly worn, dirty or scratched. During an interval, patrons are listening, if only subconsciously, to the incidental music, and any imperfection in the sound reproduction will be noticed. The selection of discs of suitable type plays its part in patron enjoyment. Timing is important; music should not cease suddenly half-way through a composition or in the middle of a bar. It is far better to have a few seconds' silence than to have a discordant change from disc to film reproduction.

Presentation of a disc programme demands a deal of thought and will repay consideration. Discs chosen by someone with musical appreciation can add much to the enjoyment of patrons, and conversely, if badly chosen, can cause annoyance to many. Disc programmes to cover an interval before presentation of a feature film should be arranged with the motif of the film in mind. The disc programme presented with "Hamlet" is an outstanding example.

Auditorium Acoustics

In considering patron enjoyment, brief reference must be made to auditorium acoustics. Sometimes the sound reproducer is giving good sound, yet hearing conditions in the auditorium are still poor. This can be caused by unsatisfactory acoustical conditions where the rate of decay of sound from maximum to inaudibility is too long. Such an auditorium will have a high reverberation period which can be corrected only by the judicious use of acoustic absorbents. In some of the larger auditoria highly reflective surfaces can give rise to echoes, or to confusion caused by one tone being superimposed upon another occurring immediately afterwards. In such cases as low a

volume as is consistent with audibility will tend to alleviate the problem.

Patrons must not have to strain to hear the sound reproduction, otherwise they will become tired through ear fatigue, which will adversely affect their goodwill toward a particular kinema.

A service designed for the comfort and convenience of patrons is the provision of a deaf-aid system for hard-of-hearing patrons. Certain seats wired for lorgnette type handsets enable these patrons to enjoy the complete film and disc programme in comfort.

3. LIGHTING

Light has always attracted mankind, and the psychological effect of light is of great importance. Skilful use of this medium will do much to attract the patron to the kinema, and to maintain that cheerful and exciting atmosphere that is most desirable. There are times when its effect should be startling, and others when it should efface its own individuality in silent and inconspicuous service.

Developments in light sources, particularly in the groups of lamps known as discharge lamps, have placed further media in the hands of the lighting engineer with which he can produce many beautiful lighting effects designed to stimulate the emotions of the audience.

Lighting the Entrance

The main entrance is the kinema's "shop-window," and it must be remembered that a greater number pass the theatre during the day than actually pay for admission. The front-of-house is the focal point of attraction, and from dusk onward the effects achieved by well designed and attractive publicity can be greatly enhanced by skilful lighting. The attention of the passer-by is caught and drawn to a kinema entrance with a brightly lighted canopy and entrance foyer, while the architectural features of the building can also be brought into prominence by the use of neon lighting and coloured flood-lighting, so that the cumulative effect of the front-of-house is warm, luxurious and inviting.



A well-lit Entrance, with the name of the Hall prominently lit ; an inviting Vestibule ; and (opposite) a tasteful Auditorium.

The objective always to be borne in mind is the creation, in every possible way, of that inviting atmosphere of comfort and relaxation.

Since we rely upon repeat orders, the goodwill built up by an individual kinema should be supported in every way, and the lighting of the name sign is an important factor as a symbol of that goodwill.

Regular maintenance and inspection of all outside lighting installations is very necessary, for lamps that have failed, the failure of a section of neon lighting or of illuminated interchangeable lettering, becomes very obvious to the passer-by whom we wish to attract, and spoils the whole front-of-house effect.

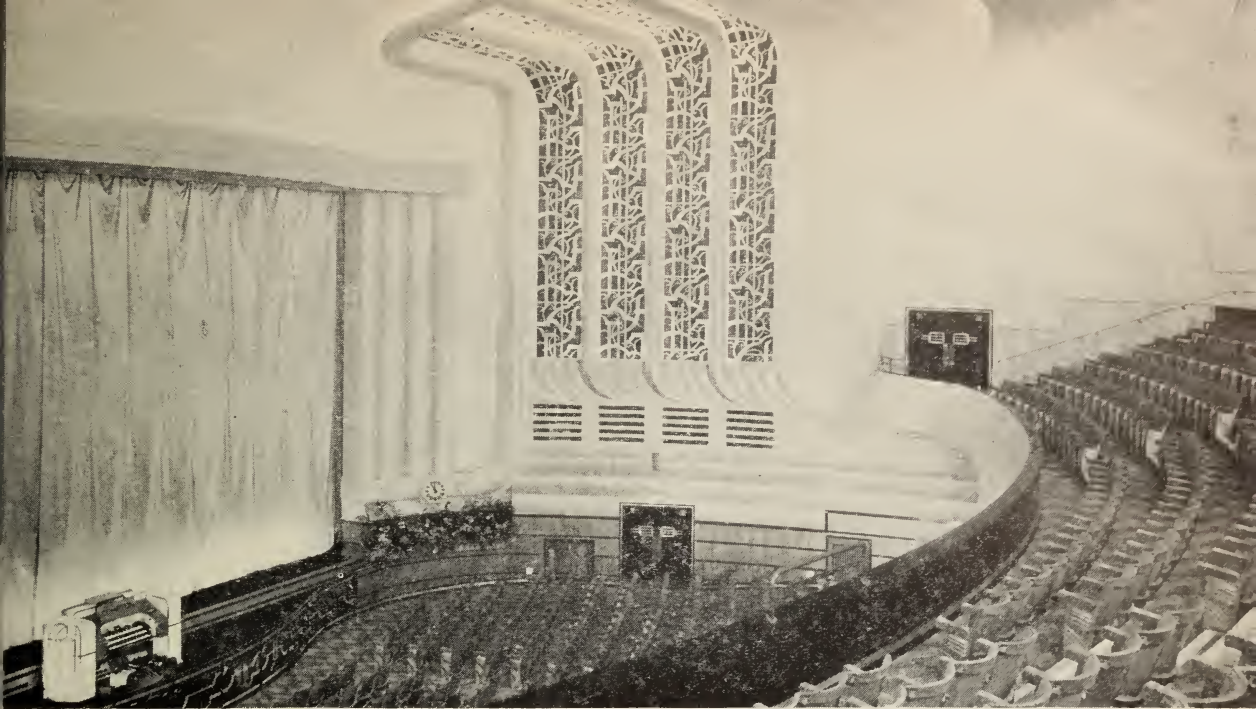
Auditorium Decorative Lighting

Within the auditorium, lighting is mainly decorative, housed in fittings designed to give a pleasing appearance and adding to the enjoyment of the patron. Smooth transition from full lighting to the warm glow of the maintained lighting will enhance presentation and maintain that slight air of mystery and unobtrusive service that are our corner-stones.

The lighting of the stage or screen end of the auditorium should be given all the at-

tention it deserves. Even the humblest kinema theatre has some form of screen end lighting, crude as it may be, and the best possible use of this lighting is an important part of presentation. This particular end of the auditorium should always look "alive." When incidental music is being played during an interval, the patrons should always have something to look at, and since an interval is always an anticlimax it behoves us to provide attractive lighting effects on the screen curtains and proscenium arch. Those who have television sets will have taken considerable interest in the fact that during the recognised intervals between items in the television programmes, incidental music is played, and instead of a blank screen, animated effects serve to provide some interest to add to the attraction of the incidental music. This in itself does tend to show that the necessary intervals during which time incidental music is rendered must form part of the programme.

The degree to which this phase of presentation can be taken depends upon two factors, the first being the extent of the lighting equipment available, battens, footlights, wing floods, number of colour circuits, number of dimmers, etc., and



secondly, upon the colour sense of the person operating the equipment. Much can and should be done in this direction, but not to the extent of painting the lily by arbitrarily altering the colour balance on the opening titles of colour films.

Maintained Lighting

Before leaving the question of lighting, reference should be made to the maintained lighting as another factor affecting patron comfort. The problem of affording adequate maintained lighting, in intensity and distribution, is one that is in itself extremely complex, and over a period of years has received a large amount of consideration by various bodies, including the British Standards Institution.

Unfortunately, there are many variables to be considered, among which are items such as decorations and furnishings, the colour and texture of which vary considerably over an extremely wide range. Another factor that must be considered is the difference in dimensions and shape of the thousands of kinema auditoria spread throughout the country. Yet another factor is that of intensity and distribution of lighting and its colour, while operational factors

such as location of exits, gangways, etc., make the problem even more difficult. Perceptibility of surroundings, even more than intensity of illumination, seems to be of key importance.

The adaptation period, over each set of circumstances that might arise, must be allowed for in assessing final results, for certain types of auditoria layout allow the patron to reach the auditorium, from what might well be a sunny day outside, without any opportunity of adaptation to the lower degree of illumination inside. Where layout lends itself it is possible to grade entrance foyers in progressively reduced intensities, so that opportunity is provided for adaptation of the patron's eye.

Proper design and distribution of maintained lighting fittings will satisfy the condition that the light emanating therefrom shall not degrade the projected picture, yet still ensure that patrons can move about with reasonable ease. The majority of patrons enter the auditorium in a receptive mood, but they will quickly change if they stumble against a seat or have to blunder about in the dark. It should be possible for an usherette to be always just at hand to guide every patron to a vacant seat.

4. HEATING AND VENTILATION

Perhaps the most important item under the heading of patron comfort is the heating and ventilation equipment, which embraces so many types of electrical and mechanical apparatus, from the simple to the complex.

Whatever the form of boiler or firing appliance or whatever fuel is used, fundamentally they all serve the same purpose, which is to raise the temperature of the auditorium and foyers to a comfortable degree whereby the patrons feel, during the winter season, that the atmosphere is warm and therefore inviting, and that comfortable climatic conditions are assured while they witness the motion-picture presentation.

Air Intake

Fundamental requirements of any ventilation system are the regular removal of vitiated air and introduction of fresh air without discomfort to, or indeed appreciation of that fact by, the audience.

Regulations usually require an amount of 1,000 cubic feet of air per person per hour, and to introduce such a quantity of conditioned air into the auditorium is a problem in itself, since any discomfort that might be caused by draughts, brought about by the fast moving air, must be avoided. It is well known that the most susceptible portion of the human body, when normally dressed, is the back of the neck and the top of the head, so air inlets need to be placed carefully with these facts in mind. In order to avoid draughts a slight internal pressure is maintained by extracting only about 75% of the air intake.

Whatever the extent of the installed plant, it follows that efficient and intelligent operation will have a considerable bearing upon the degree of comfort experienced by the audience.

When a kinema has the advantage of being equipped with an air washer this should be in operation whenever the air intake fan is working, for this procedure goes a long way to slowing down the inevitable deterioration of the decorations and furnishings.

Temperature Control

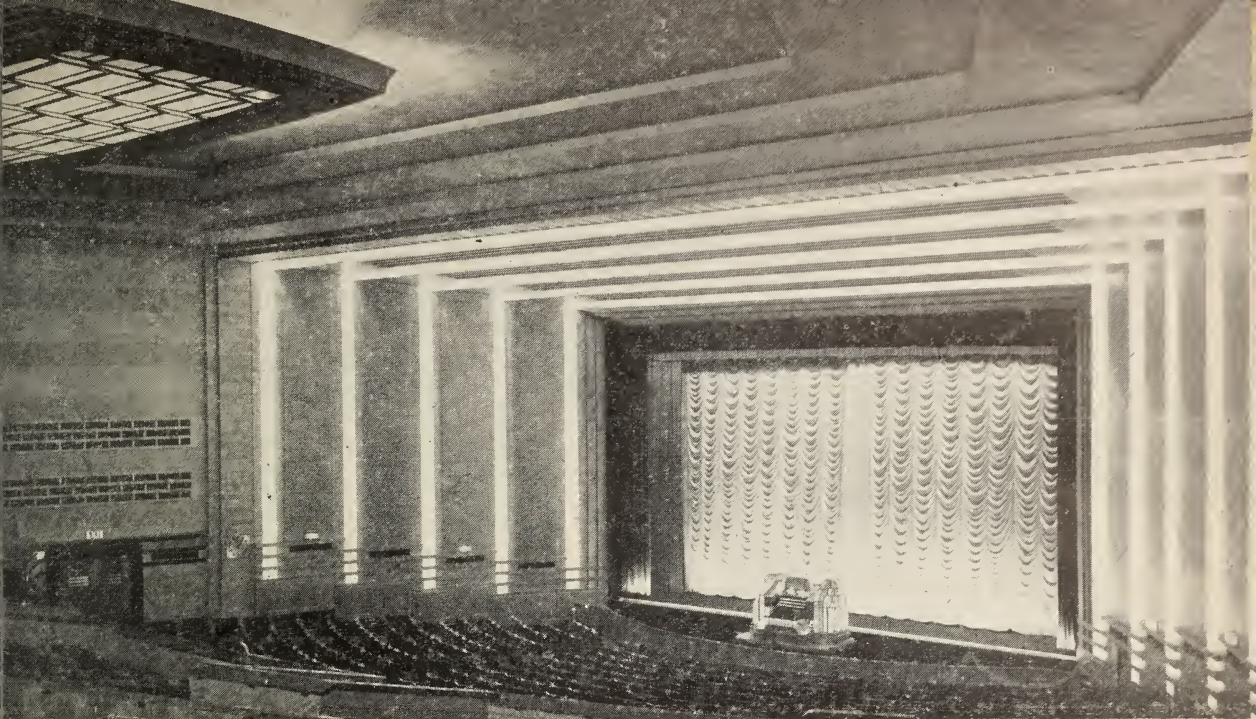
The air washer also assists during the hot weather in producing a cooling effect on the incoming air, enabling comfortable conditions to be maintained in spite of high outside temperature — another important aspect of patron comfort and attraction.

Climatic conditions within the auditorium have a tendency to vary over short periods of time, depending upon such factors as the number of persons in the auditorium and sudden changes in outside temperature. These sudden variations can be smoothed out by intelligent operation of the equipment, thereby assuring patron comfort, especially that of the elder patrons, for a badly run plant does undoubtedly affect box office takings adversely. The person operating the heating and ventilation plant should develop his sense of weather consciousness and be able to anticipate changes in temperature, thus avoiding the necessity of drastic action that may have the apparent effect of draught.

Requirements of Heating Plant

Naturally, the extent of the heating and ventilation plant varies considerably over the range of kinemas, and in the older buildings consists generally of radiators for heating and extract fans for ventilation. With such installations fresh air is usually drawn from the outside of the building through the doors or through air vents behind the radiators, and as such air is usually cold, it often causes discomfort to the patrons seated near to the points of entry. In many kinemas regular patrons know these draught spots and avoid such seating positions, so it is found that certain seats are always unoccupied unless all others are filled.

The incoming air will follow the easiest path, which is generally through the doors, and while such doors can be covered by curtains to prevent draughts, this precaution nearly always adversely affects ventilation through reduction of the air flow. Further, radiators are comparatively slow in action and cannot readily cope with a rapid rate of ventilation, and, of course, difficulty arises in adjusting radiators to compensate



An Auditorium with well-balanced Proscenium and attractive Lighting.

for sudden changes in atmospheric conditions.

If the entrance foyers are kept warm, discomfort from cold draughts can be reduced considerably, especially if the main entrance doors are kept closed as much as possible.

Air Velocity

The larger and more modern kinemas are generally provided with plenum systems designed to allow rapid ventilation and to reduce draughts to a minimum. Even with a plenum system, discomfort can be caused if the incoming air is not maintained at the right temperature, for the air in the auditorium moves at a rate which is four to six times as fast as that to which patrons are normally accustomed in a sitting-room, office or shop.

The temperature of the air passing through the delivery grilles should, therefore, approximate that required inside the auditorium, bearing in mind the adjustment necessary to compensate for the difference between a full and half-empty auditorium. If the air being introduced is too warm, then almost as much discomfort can be caused as if there were cold draughts, so this point must be watched, and thermometers are

generally positioned at strategic points within the auditorium, so that temperatures may be constantly checked.

Some kinemas are equipped with thermostatic control applied to the air heating plant, and in some instances to the boilers also, and thus a certain degree of automatic regulation is achieved, but the plant still cannot be left to look after itself.

5. FURNISHINGS

Patrons spend a long time seated in the auditorium, and while it is hoped that during the major portion of that time they are blissfully unconscious of their surroundings, there are times when they become acutely conscious of seating comfort.

Seating Comfort

Adequate seat spacing is a factor in comfort, and in enabling reasonable ease of movement between rows. Conventional spacing lies between 30 ins. and 36 ins., but adoption of the latter figure could, of course, mean an appreciable loss of seating capacity. Some compromise between maximum degree of comfort and practicability has to be arrived at, generally depending purely upon local conditions. Over-

emphasis can be placed on the importance of seat spacing, as statistics tend to indicate that patron disturbance in the average kinema running continuous performances is not nearly as high as might be imagined.

Considerable investigation has been carried out on the characteristics of the human body when seated, which has resulted in an available range of seating covering maximum comfort related to degree of cost. Sitting space is more important than passing space, and seat design is not a simple matter as it might at first appear.

Floor Coverings

Carpeting in a kinema is a further factor adding considerably to a feeling of comfort on the part of the patron. Everybody likes to walk on a carpeted surface that is resilient, giving slightly to the feet, and thus promoting a sense of luxury. Colour and design have an important bearing on this feeling. A good carpet deserves a good underlay, for not only does this add to the feeling of luxury, but it has a decided effect in slowing down the rate of deterioration. The acoustic properties of the floor covering must be borne in mind.

Design of carpeting in gangways and foyers can have considerable effect upon the safety factor and the ease of operation in handling a continuous two-way traffic.

Aesthetic considerations are not the only considerations, however, for durability of appearance and structure must be taken into account if the carpet is not to wear unduly and, therefore, become unsightly if not hazardous.

Care and maintenance of carpet then become of paramount importance if the original aesthetic and practical requirements are to be preserved, and involve a due appreciation of the correct technique in cleaning.

The fact that the decorative features and carpeting of foyers have a distinct appeal to the feminine section of the audience should not be lost sight of.

Wet-weather Precautions

One of the mixed blessings of the exhibition side of the industry is wet weather, for

while it brings in extra patronage, it also brings in water and mud, both enemies of a clean and cheerful atmosphere. Anything that can be done to ensure an immediate feeling of warmth and comfort to patrons entering the kinema from wet weather conditions should certainly be given due attention.

The entrance foyer or vestibule is the part of the theatre most affected by wet weather, and here, grooved mats or floorings by the entrance doors can do much to take dirt off the shoes of the incoming patrons and disperse the water that is shed from shoes and clothing.

While, for many reasons, opinion varies considerably on the type of flooring most suitable or desirable for the needs of the kinema vestibule and foyers, terazzo and marble are accorded high places in most minds for their durability and attractiveness through the infinite variety of design. Others however prefer a softer flooring such as rubber, which when laid properly is both durable and capable of effective range of design.

The appearance of a floor has much to do with its attractiveness and is again a matter of proper care and maintenance.

6. STRUCTURE

There is little need to stress the important part that the actual structure of the kinema fills in catering for the comfort and enjoyment of the patron. Lay-out of auditorium, entrance foyers and exits in any particular case soon make themselves felt in the ease of operation.

The kinema of today is a complicated structure of considerable value, calling for constant care and maintenance from the structural point of view to make sure that the causes of deterioration may not ultimately lead to the lessening of patron comfort.

For thousands of years mankind has searched in vain for materials for buildings that would not deteriorate or decay with the passing of time. Since nothing on earth has a permanent nature, wind, rain and air, containing natural chemicals as well as man-

made impurities, contribute to the slow but inevitable deterioration.

7. CLEANLINESS AND MAINTENANCE

Cleanliness is known to be next to Godliness in the projection suite, but this maxim should apply equally well in the kinema generally. Obvious cleanliness goes a long way to promote comfort and to create a good impression on patrons visiting that particular kinema for the first time.

Cleanliness also helps to maintain the furnishings and decorations in good condition, thus enhancing the appearance of the auditorium and foyers.

It is the engineer's job to provide adequate cleaners' lights and mechanical aids to cleaning, such as the permanent vacuum cleaning plant which is to be found in many kinema theatres.

Maintenance of Equipment

It would not be reasonable to conclude these remarks without reference to maintenance of structure, furnishings, and plant as having an indirect but very definite bearing upon patron comfort and enjoyment.

In a place of public entertainment a fault is always very obvious and sometimes magnified into a disaster. Perhaps the screen will suddenly go blank, the sound reproduction becomes a faint or intermittent whisper, perhaps it is a lamp here or there that has failed and not been replaced, a section of the neon lighting out, or a hundred-and-one other things.

Prevention has always been better than cure, and while a fault may be corrected in the minimum of time, and everybody concerned indulge in a bout of self-congratulation, it would have been a lot better if the fault had never occurred.

Statistics prove beyond all possible doubt that regular and thorough maintenance of equipment would have prevented over 70% of the faults that lead to patron annoyance. Further, the amount of money spent in re-

pairing equipment that has been misused or neglected would go a long way to the provision of more comfort and enjoyment to our patrons which in itself would have resulted in a considerable increase in the number of patrons visiting the kinema theatre.

It is impossible to over-emphasise this point of adequate and regular maintenance, which, coupled with intelligent operation of the many different equipments to be found in the kinema theatre, results in trouble-free presentation of high standard.

8. CONCLUSION

In some cases nearly three hours motion-picture entertainment is provided for the patrons, and if they are to be encouraged to turn always to that particular form of entertainment, then they must leave the kinema theatre with a sense of satisfaction, relaxation and complete enjoyment, not with a feeling of frustration through experiencing petty annoyances and minor irritations.

The authors hope that this review will serve to indicate the many facets of motion-picture presentation, the hundred-and-one items that must all receive due consideration and not be dismissed as trivial. The line of least resistance is so tempting, and unless the full number of pieces of the jig-saw puzzle are placed correctly there will be no picture in its completed form. Perhaps this review will inspire those connected with the final act of motion-picture presentation to give of their best for even better patron comfort, service and enjoyment in the cause of "Better Business."

Acknowledgments

The authors wish to thank those who have contributed constructive criticism and to Messrs. Columbia, G.F.D., Paramount, R.K.O. Radio and Denham Laboratories, many thanks for assistance in the provision of sections for the film sequence shown with the paper.

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DISCUSSION

MR. BRADLEY: What type of screen is considered the best for improving picture illumination?

MR. PULMAN: One has to consider the type of auditorium. Experimental work is being carried out in regard to types of screens that will show the picture where the audience is seated, and not on the ceiling or in the orchestra pit.

MR. R. H. CRICKS: The Americans have discovered recently that the rounded corners to the screen have a psychological advantage over square corners. The film frame has rounded corners.

MR. SWINGLER: I do not agree that the Americans have found it better to have rounded corners. We have decided in this country that the 90° angle of masking is correct. The round corners on the film are not very prominent.

MR. A. R. RANDALL: Have the authors any views on the practice the Americans are attempting to institute, whereby they have fixed houses for showing a particular film?

MR. SWINGLER: The industry has fostered the continuous programme almost since its inception; habit takes a considerable amount of breaking.

MR. R. BROMHEAD: I think this paper is most opportune, at a time when the whole industry is trying to work together—to remind us of those elements of showmanship and good service to patrons which there has been such a regrettable tendency to forget over the past years. In the war years it was quite impossible to pay attention to the many important facets of patron service, and

although the war has been over for five years, unfortunately the exhibiting industry as a whole has not gone back to them again. I should like to acquire a good many copies of the paper to see that they are properly distributed. Only if we give patrons enjoyment and relaxation can we rely upon them to come regularly to our kinemas.

A questioner mentioned the tendency in America to try to insist that people should come at the beginning of the picture. This policy has been withdrawn owing to opposition from exhibitors.

MR. BAYNHAM HONRI: Not much was said about the most vital part of the projector, the Maltese cross. The Maltese cross and sprocket have come to be a standard, largely because of the variation in the shrinkage of film. Recent experiments we have been making in the studio may be a pointer to things to come. Nitrate prints are not sufficiently stable, but we find with the new safety base that prints straight from the laboratory will run perfectly satisfactorily on the B.P. projector. The fact that safety base does not shrink so much as nitrate might have an effect upon the policy of projector designers.

MR. PULMAN: We on the engineering side feel that safety base is going to help us in every way, not only from the point of view of regulations but also from the mechanical point of view.

MR. W. S. BLAND: In the present standard of screen illumination the limits set are so wide that

it is impossible to produce a print which is going to give reasonable results over all projection conditions. Until the limits are closer, I do not think the halls are ever going to be encouraged to improve their illumination, and we shall get a very bad discrepancy from one place to another.

In regard to screen masking, the standard does actually show a rectangular opening with round corners if required.

I am particularly interested in the sound level of news-reels. So often news-reel dialogue comes over much too low. One possible reason is that the dialogue of news-reels is recorded considerably louder than that of features, because it is declaimed somewhat, and therefore it should be louder than the normal spoken dialogue.

Mr. PULMAN: I think any motion picture engineer would agree that the present standard of screen illumination is very wide.

In regard to the third point, the good projectionist will obviously use his intelligence in order to compensate and produce the best possible level. News prints are very variable, and I do not think that most projectionists alter the fader unduly.

Mr. BUCKLE: Is it not a fact that news-reels are recorded at a high level? The average programme is run at a fader setting of between 5 and 8; we find by experience that a news-reel can be run on 3, and still give quite an audible response.

Mr. SIMPSON: Copies vary considerably in density, and no matter how much screen illumination we give, we are handicapped by the copy.

The majority of kinemas in this country are without adequate heating and ventilating. In America there is no smoking. They are viewing a copy in the best of conditions, as in the studio.

Mr. PULMAN: Until we provide a fairly close range of screen illumination, production and laboratory people cannot grade prints according to our wide variation. Considering this, they turn out prints that are very good. It is the exhibiting side that needs to get screen illumination tightened up.

Mr. L. KNOPP: I was a member of the British Standards Committee that prepared the recommended standards for screen brightness. The Committee comprised a number of skilled observers who determined the limiting levels of illumination which, in their opinion, were acceptable. The Committee was not influenced by current practice nor by the equipment at present in use. It is interesting to note that another similarly constituted Committee working in America without either liaison or collaboration with the British Committee, determined the same limits of brightness. Mr. Pulman now considers that the limits should be narrow, and it may well be that when the standard of discrimination of the kinema-going public has improved, the British Standards' re-

commendations will require to be modified accordingly.

Mr. SIMPSON: A number of productions have night scenes and other dark scenes. In a first-class hall you may have no difficulty, but in a hall in an industrial area, where you have a lot of fog and bad atmosphere, it is well-nigh impossible to see the picture at times.

Mr. W. LASSALLY: It is surely to be deplored that any changes should be made on the production end, from the point of view of night scenes, by reason of the bad conditions in certain halls.

Could not some electrical interlock be produced which would prevent the colour floods being on the screen at the same time as the projector?

Mr. SWINGLER: The screen curtains may be coupled with a trailer dimmer, to dim the stage lights slowly at the same time as the screen tabs opened. From the presentation point of view, I consider that bad, because it encourages the certificate being shown on the screen tabs. Showmanship, as I—a mere engineer—know it, does not stop with merely dimming lighting on the stage and presenting your film. Showmanship is a combination of art not only of the studio technicians and of the laboratories, but of the people who are responsible for presenting the finished product to the patron. Colour in itself forms part of the entertainment. One must therefore have the opportunity of lighting the stage and/or the curtains and be able to vary the colour combinations. It is impossible to do this when one has a trailer dimmer attached to the curtain motor.

In my opinion, it is psychologically incorrect to look at a picture which is surrounded by 3 ft. of black border.

Mr. S. A. STEVENS: One point about the loss of illusion that neither speaker raised is the visibility of the beam of light from the porthole to the screen. As long as we have front projection, and as long as we go on smoking, it seems that we must have this feature. The Theatre Division is presenting a paper on the subject of rear projection, in which the beam of light is on the other side of the screen.

A VISITOR: All advertising material should be kept off the screen, apart from the trailer giving next week's programme.

Mr. SWINGLER: Speaking of the organisation in which I am employed, 99 per cent. of our theatres do not show slides; we use 90 per cent. Technicolor trailers. Nobody objects to a clever advertising short.

Mr. W. V. DEWAN: Will the day ever arrive when we can increase our screen illumination and match the density of our prints, and so do away with that evil, the usherette's torch?

Mr. PULMAN: The answer is yes.

TECHNICAL OBJECTIVES IN PRE-PLANNING PRODUCTION

K. E. Harris, B.Sc. (Member)*

Read to a joint meeting of the British Kinematograph Society and the Association of Cinematograph and Allied Technicians on November 15, 1950

THE purpose of Operational Research is to provide an executive with a technical balance sheet. This gives the arguments for and against a particular course of action, together with a relative statement of the importance of each factor. It will often not be possible to make a quantitative assessment of all the factors involved in a given course of action. In such cases a qualitative statement is all that can be attempted. There is some danger that a statistician will concentrate on the parts of a problem which can be analysed statistically. That is why an operational researcher is not simply a statistician.

The work of Operational Research is first to determine the objective for which a given operation is to be carried out and then to state and analyse the possible alternatives.

Purpose of Pre-planning

Considering then the technical objectives in pre-planning a feature film production, the first work of Operational Research is to enquire what purpose is to be served by the planning. There are many possible answers to this question. For the purpose of this discussion I take it to be "consistent with an adequate scope for artistic expression to arrange for a film to be produced in the smoothest possible manner with the greatest economy."

It is often argued by the opponents of objective analysis in picture planning that one might just as well analyse the cost of brushes, paint and canvas in the painting of a picture. This is, I think, a good analogy and it illustrates the limitation of Operational Research, or pre-planning, with respect to motion pictures. It can comment only on

the tools of the trade and the method of their application. It can say nothing about the quality of the picture as such. The difference is simply that in the case of the motion picture the cost of the tools and methods is enormous, so that they become well worth comment.

In a short paper it is impossible to prepare the technical balance sheet for "pre-planning." I have, therefore, chosen three subjects which may be of some interest. The facts given will not be the whole story, but they may serve as starting points for further discussion. The three subjects to be considered in this arbitrary and incomplete manner are:

1. Planning the division of a film into "slates."†
2. Restriction of the number of "takes" of each "slate."
3. Consideration of "retakes."

I. PLANNING THE DIVISION OF A FILM INTO "SLATES"

An analysis of the production records of completed films shows clearly that an increase in the length of slates from which a film is composed offers a possibility of considerable saving in the time spent with the film on the floor.

The Principle of the Longer Slate

Within a typical modern first feature film, slates are found varying in length from a few seconds up to as much as several minutes. Information may be derived about the effect of slate length on time spent in preparation and shooting over a considerable range of slate lengths. A detailed study has been made of several first feature films. Fig. 1 is part of a chart

* Sir Robert Watson-Watt & Partners, Ltd.

† The term "slate" originates from the fact that a separate number is chalked on a slate for each new camera set-up. It is that part of the action in the shooting of a film which is recorded by the continuous running of the camera.

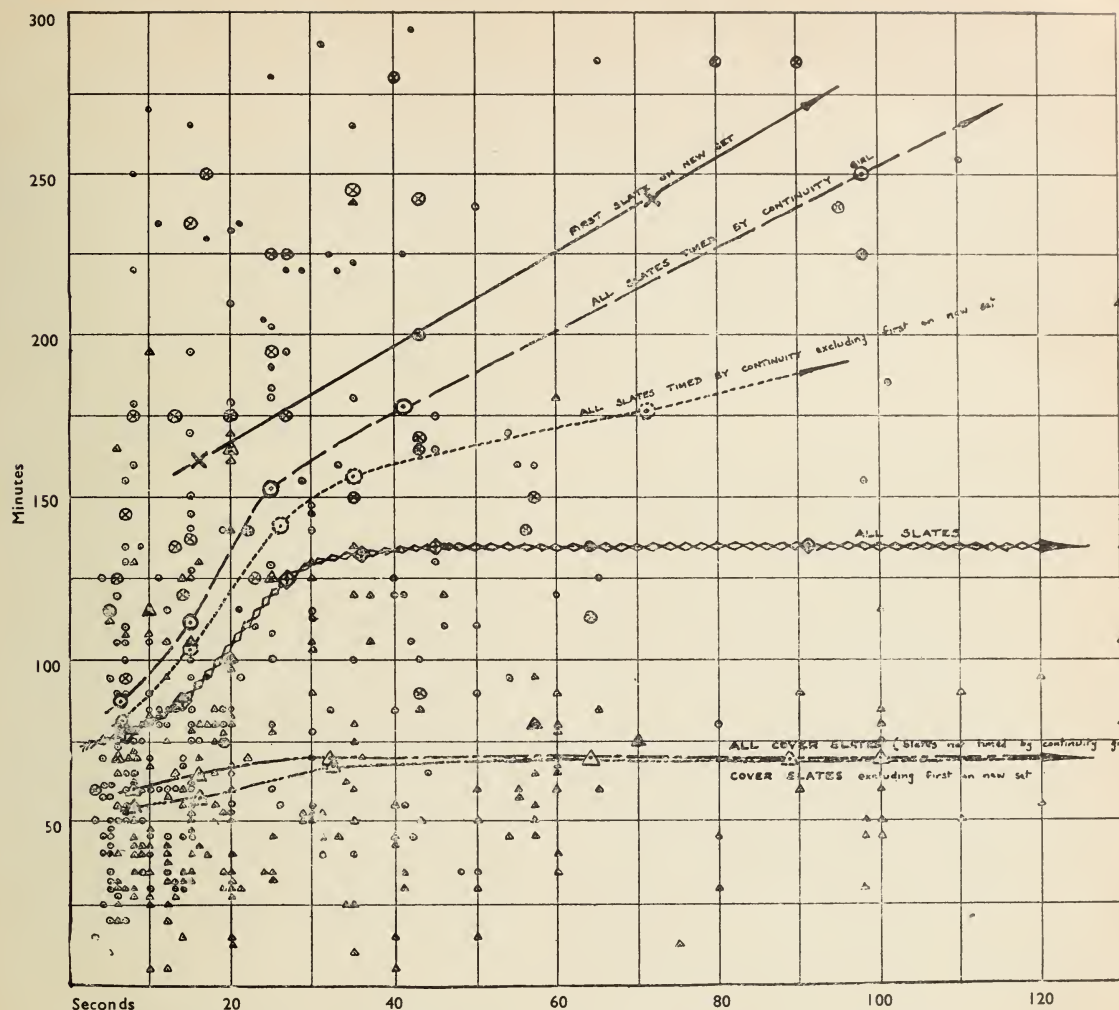


Fig. 1. Time of shooting Slates (minutes from cut to cut) plotted against Screen Time. ϕ First slate on new set, timed by continuity girl. \blacktriangle First slate on new set not timed by continuity. \odot Timed slates other than first on new set. \triangle Untimed slates other than first on new set. ("Untimed" means not timed by continuity girl—these slates were subsequently timed for this record).

Parts of the chart, extending above 300 minutes and beyond 120 seconds, have been deleted to save space.

showing the total time spent in preparing and shooting each studio slate in one typical film, plotted against the time for which the action of the slate runs. Different types of slate have been marked by different symbols, but for the moment it is sufficient to take them all together. In spite of the fairly wide scattering of the points over the piece of paper the arithmetic means taken in groups over 10-second intervals of slate length lead to a fairly smooth mean curve shown by the diamond line; all slates longer

than 50 seconds have been taken together because of the small number of them.

The significance of this curve is that at every point on it the slope of the curve is shallower than that of the line joining the point to the origin, and indeed beyond 40 seconds slate length the curve is nearly horizontal. This means that an increase in slate length results in a less than proportionate increase in time spent. The ratio of the proportionate increases in time spent and slate length is in fact equal to the ratio

of the slopes mentioned, and is very nearly unity beyond 40 seconds slate length. A given length of film action is, therefore, shot more quickly in a small number of long pieces than in a large number of short pieces. For example, reading from the curve, a scene lasting 100 seconds would take about 135 minutes to shoot if shot as one single slate, but would take about 270 minutes if shot as two separate slates each 50 seconds long, and 800 minutes as ten slates each 10 seconds long. This seems to point the way to considerable economies in film production.

Criticisms of Findings

Before developing these arguments further it would be as well at this point to consider some possible objections. The first serious one is to the use of the diamond curve of Fig. 1 as the basis for arguments. The wide variations in time spent in shooting even slates of similar lengths can be due to all sorts of factors. For example, whenever a new portion of the script is broken into, extra time is spent in setting-up and rehearsing, whereas for subsequent cover shots the setting and action remain the same; cover shots could therefore be expected to be shot more quickly than average. Whenever the production unit moves over to a new set, extra time is spent in the physical move and in getting lighting rails into position before the normal work can commence; the first slate on a new set could, therefore, be expected to take longer than average.

It is conceivable that a new production technique based on longer slates might result in less cover shots, and to show the upper limit to the effect this could have on the basic curve of Fig. 1 the curve indicated by dashes has been drawn, omitting all cover shots, i.e. omitting all slates recorded by the continuity girl as adding nothing to the total screen time because that part of the script was already covered by an earlier slate.

Pushing a production technique based on longer slates to its very limit might result in every slate involving a move to a new set,

and the effect of this is shown by the continuous curve which is the mean of only those slates which were the first on a new set.

Problems of Longer Slates

Both these curves have the important characteristic of the original diamond curve that they are shallower at every point than the line joining that point to the origin. Shown in the worst possible light a change to longer slates might involve a transition from a point on the diamond curve to a point further along the continuous curve. The average working position on this film was at a mean slate length of about 30 seconds, taking 130 minutes to prepare and shoot. The line joining this point on the diamond curve to the origin intersects the continuous curve at about 50 seconds slate length, so that even viewed in this light an increase in average slate length would seem to give an overall reduction in time spent on the floor, provided the average slate length were increased to at least 50 seconds.

A second objection is that the possible length of slates depends on the way in which the story to be filmed is scripted. Certainly the story will place an upper limit to the average slate length, but this is a limitation on the application of the principle being developed here, and not a fundamental attack on the principle itself.

Deductions from the Evidence

The main argument continues by deducing that a given length of film action would be shot in a shorter total time and, therefore, at less cost than at present by shooting a smaller number of longer slates. The evidence is certainly adequate to support this contention for slates up to one minute in length, and suggests it could be extended to two-minute slates, though the weight of evidence begins to get thin there. How much further the principle could be extended can be determined only by trial.

The arguments just developed were applied to a given length of film action. There remains the factor that the amount of material which must be supplied to the

editor, measured by the total film action time it contains, will depend on the length of the individual pieces. For example, by shooting each cut in the finished film as a separate slate it would be possible to provide no more than the exact amount of film which was to be used. The "cutting cover," defined as the percentage excess of total film action time provided to the editor over the length of the final edited film, would then be zero.

On the other hand, if a standard cutting technique is to be adopted, the longer the individual pieces of film supplied the more cuts the editor will have to make in each length, and therefore, probably, the greater the amount of cutting cover required. There is some information on the magnitude of this effect from existing feature films. The evidence suggests that there is in fact an increase in cutting cover when the average slate length increases. This view is stated as a result of examining a number of first feature films and comparing average slate length and percentage cutting cover. To determine the law relating the two requires a considerably greater analysis than has so far been attempted; but *a priori* judgment suggests that the amount of cutting cover required will approach an upper limit as slate length is increased beyond a certain point.

Cover Shots

It is noticeable from Fig. 1 that the time taken to obtain a cover shot is practically independent of its length. First this reinforces the argument of the last paragraph, since it means that any increase in cutting cover required when the averaged slate length is increased takes less time to obtain than a completely new slate. Secondly, it suggests the separate conclusion that when a cover slate is being shot it might as well be taken to cover the whole scene, since little or nothing is thereby added to the time taken, and the extra material might be useful to the editor.

It is thought that the principle of making slates longer should be borne in mind in planning in the production offices. Quite

often there are cases where several shots which are now taken as individual slates could be combined.

It is not proposed that the form of the finished film should be altered. The director must still be free to tell his story as he wishes. The possibility of telling the same story in the same way while applying the principle of lengthening slates wherever possible has been investigated. From this analysis it appears that significant saving is possible without altering the film.

Can the same film be made in shorter time?

Broadly there are two ways in which longer slates might be made to produce the same film. The first way requires the "rolling together" of several slates within a given sequence. The second way requires the shooting as one slate of pieces of the picture which take place in the same setting but do not necessarily appear near one another in the finished film.

To take an example of the first method, it may be possible with a long tracking and panning shot to take into one slate several slates which were previously shot separately. Subsequently, so that there is no difference in the finished film, the long slate would be cut into pieces corresponding with the individual shorter slates previously taken.

To give an example of the second method of "rolling slates together," it may be possible, if two different characters proceed up the same staircase under similar lighting conditions but in different parts of the film, for the first to go upstairs followed after an interval by the other with the camera turning the whole time.

Considerations in Joining Slates

Some assumptions have to be made in deciding whether slates previously taken separately can be joined together. First it is assumed that the director will certainly wish to use the same camera viewpoints and the same lens as he previously used. Slates using different viewpoints can only be joined by tracking or panning the camera.

It is next assumed that it is sometimes possible for a tracking and/or panning shot

to be satisfactorily lit. This is clearly possible in some cases because it is now done. A little judgment has, however, to be exercised in deciding when two slates from different viewpoints may be joined together. It is necessary to see that there is a reasonable possibility of being able to arrange the lighting units, further it is necessary to ensure that any tracks laid will not get into the field of view of the camera, and to be reasonable about the number of different directions in which the camera looks during its progress.

The tempo at which it is required to play the scene may also need to be altered when slates are joined. A pause may be required at what was previously a cutting point while the camera moves to a new position, or it may sometimes be necessary to repeat dialogue so that intercutting is possible.

In working from one sequence to another which will be on the screen at a different time all these points must still be borne in mind. In addition, it has been assumed that the director will still require as much variety of costume and make-up as he demands at present. Scenes in which there are costume changes or other important continuity changes can never be joined into the same slate as those with different continuity conditions.

Prospect and Retrospect

It is realised that there is one important objection to this enquiry. It is that although it can be seen in retrospect that some of the slates in a film might have been joined differently, it is by no means to be concluded that it would have been possible to arrange them differently in prospect. This point is fully appreciated. The present analysis is simply directed toward determining if reasonable saving of time on the floor might be expected from a different production office approach to picture making.

This different approach is that the production manager, producer and director should try to make longer slates wherever possible, even if this demands some ingenuity in the "rolling together." This

is not the present procedure, because it is more natural and simpler for the director, producer and editor to consider picture making from cut to cut. The director thinking from cut to cut can see his picture progressing as he goes. Furthermore, with shorter slates apparent progress is faster than with longer ones. This can be illustrated from the curve of Fig. 1. It can be seen that the average time of preparation for a master slate of 100 seconds screen time is 250 minutes. The average time for a slate contributing 10 seconds screen time is 100 minutes, so that with the shorter slates an obvious step is made in one and a half hours or so, with the 100 second screen time slate it is nearly four hours before the slate is finished.

Production Analysis of a Film

Every shot in seven of the major sets of a recent first feature film has been examined. The camera viewpoints, the lens, the type of lighting, the actor's costume and other continuity details, together with the screen time contributed by the shot, and the total preparation time, have been observed. An examination of the possible reduction in number of slates by joining those which were taken has been made. A summary of the results follows. The seven sets are divided into three qualitatively different groups.

Group I: Sequences on One Set

The first group contains only one set, the "Hotel Lobby." It is visited for a large number of small sequences throughout the run of the film. There were originally 34 slates which took 4,381 minutes to prepare. Reading from the curves of Fig. 1 it will be seen that from the "all" curve it would be expected that 34 slates, having the particular individual screen times of the actual slates, would take 3,535 minutes to prepare. Reading from the "master" curve it would be expected that the preparation would take 4,465 minutes. It appears, therefore, that the conditions of the "master slate" curve are applicable to this particular series of slates. This seems justifiable

because, as has been explained, the sequences are generally short and there is not a great deal of cutting cover involved.

Applying the principles of "rolling together" within the sequence it is possible to reduce the number of slates to 28; the total preparation time from the "master slate" curve would then be expected to reduce to 3,990 minutes, a saving of 475 minutes in a total of 4,465 minutes (10.7%). Applying the "rolling together" both within sequences and from one sequence to another, it is possible still further to reduce the number of slates to 21, the total preparation time of which would be 3,325 minutes, a saving of 1,140 minutes in 4,465 minutes (25.6%).

Group 2: Sequences on Three Sets

The second group includes three different "sets," the "First Floor Landing and Stairs," the "Top Landing and Stairs," and "X's Room." These are all similar in the respect that a fair amount of "rolling together" can be done both within the sequences and across the separate sequences in the same set. In the three taken together a total of 42 slates was originally shot. These slates actually took 4,341 minutes to prepare. Reading from the "all" curve it has been determined that it would have been expected that they should take 4,336 minutes to prepare. Reading from the "master slate" curve the expectation is 5,840 minutes. This shows that the proportion of "master slates" and "cover slates" in these sets justifies working from the "all" curve.

Combining within the separate sequences results in a reduction to 31 slates; the time of preparation from the "all" curve would be expected to be 3,200 minutes, a saving of 1,136 minutes in 4,336 minutes (26.3%). Further combining across the sequences results in a total of 20 slates, the preparation time for which, reading from the "all" curve, would be expected to be 2,395 minutes, a saving of 1,941 minutes in 4,336 minutes (44.6%).

This last figure must, however, be treated with great reserve, because it is possible in

reducing the number of slates in this drastic fashion that the proportion of "cover" to "master" slates has been seriously altered. It might therefore, be more fair to work from the "master slate" curve, in the second case at least, and doing so we find an expected preparation time of 3,675 minutes for the 20 slates. This is still a saving of 661 minutes in 4,336 minutes (15.2%), and it clearly takes a fairly pessimistic view of the saving of time to be expected; the real figure probably lies somewhere between this and the optimistic one obtained by working from the "all" curve.

Group 3: Sequences on Three Sets

The final group includes three "sets," the "Hotel Lounge," the "Workshop," and the "Interior of Y's Room." These are all similar in that no rolling together across sequences is possible because of continuity changes. Further, no "rolling together" is possible within two of the five sequences which occur in these sets. As a consequence the 31 slates originally shot can be reduced only to 25. The 31 slates took 3,513 minutes to prepare.

Working from the "all" curve the expected preparation time is 3,560 minutes, and working from the "master slate" curve the expected time is 5,055 minutes, so that again it is seen that it is the "all" curve that is appropriate, and reading from this curve it has been determined that the expected preparation time for the 25 slates would be 3,045 minutes, a saving of 515 minutes in 3,560 minutes (14.5%), the amount of reduction being so small as to justify working from this curve.

Summary of Findings

Taking all the sets examined together, there were originally 107 slates for which the expected preparation time, working from the appropriate curves, was 12,361 minutes. In practice the actual preparation time was 12,235 minutes. Joining slates within sequences only, a reduction to 82 slates appears to be possible. From the appropriate curves the expected preparation time for these 82 slates would be 10,235 minutes,

a saving of 2,126 minutes in 12,361 minutes (17.25%). Working across sequences in addition, the number of slates could be further reduced to 65. There is now some doubt about the appropriate curve to use for the reason explained above. The optimistic use of the curves produces a preparation time of 8,765 minutes, a saving of 3,596 minutes in 12,361 minutes (29.2%). The most pessimistic view predicts a preparation time of 10,045 minutes, a saving of 2,316 minutes in 12,361 minutes (18.6%). The true figure probably lies

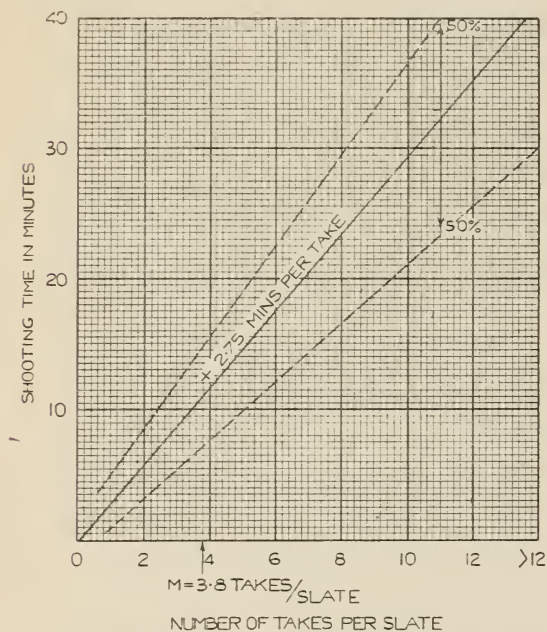


Fig. 2. Shooting Time plotted against number of Takes.

somewhere nearer the pessimistic than the optimistic end of the scale, and we might guess that the maximum saving would be about 20%.

To summarise, therefore, there seems to be a chance of saving 17% of the floor time by alterations within sequences alone, and a further addition of a few per cent. by more complicated alterations which cut across sequences and sometimes alter for shooting purposes the relative order in which the events will appear in the finished picture.

These figures are very rough and ready. They hold out hope of a sufficiently important saving of time in production without an alteration to the finished product to justify adoption of the longer slate technique in a pilot production.

2. NUMBER OF TAKES

The next quite separate subject is the possibility of saving time on the floor through a reduction in the number of takes per slate.

Will a Reduction in the Number of Takes per Slate Save Money?

About 400 stage slates having an average of 3.8 takes per slate are shot for a normal first feature production. At present shooting time is about 13% of the total time spent on all operations on the floor.

Fig. 2 has been prepared by averaging for a number of films the shooting time and plotting against the number of takes. The result presented here is for all slates: the analysis itself distinguished between classes of slate both according to their screen time and the complexity of camera movement.

Each take requires 2.75 minutes on average to shoot, so that a normal film of 400 stage slates would need 4,180 minutes shooting time. Such a film would be on the floor for about 11 weeks. The potential

TABLE I
POTENTIAL SAVING BY REDUCTION OF TAKES

Average No. of Takes per slate	Shooting time in minutes for a 400 slate production	Equivalent in days spent on the floor	% saving on total film time
3.8	4,180	7.3	nil
3.0	3,300	5.8	2.7%
2.0	2,200	3.9	6.2%
1.0	1,100	2.0	9.6%

saving if the average number of takes can be reduced (without altering any other condition) is given in Table I.

It will be seen then that even if the average number of takes per slate is reduced to 2 (below which it is surely impossible to aim) the saving of time on the floor is 6%. It is then just worth examining if there is a way of effecting this reduction.

Reasons for Additional Takes

The following table shows the reasons for additional takes on two typical productions:

TABLE II
ANALYSIS OF CAUSES OF ADDITIONAL TAKES

	Production A		Production B	
	No. of Takes	%	No. of Takes	%
SATISFACTORY TAKES: including those which were printed and held	1,174	45.4%	1,362	51.7%
UNSATISFACTORY ACTION: including bad action, missed dialogue, missed positions	964	37.3%	922	35.0%
CAMERA: including bad following or focus	70	2.7%	82	3.1%
including technical faults	71	2.8%	10	0.4%
SOUND: including noises outside the unit's control such as aircraft overhead, arc noises and technical faults	146	5.7%	145	5.5%
LIGHTING: including flickering arcs, mike shadows, matching and technical faults	101	3.9%	39	1.4%
COMPOSITION: including unsatisfactory set-up, failure of special effects	32	1.2%	66	2.5%
BACK PROJECTION: including unsatisfactory plate	4	0.2%	1	0.0%
NOT KNOWN	19	0.8%	10	0.4%

The first impression is that many takes could be saved if artistes were more thoroughly rehearsed before the cameras begin to turn. This might or might not save total time on the floor. It clearly requires more rehearsal time, but this might be found while lighting is going on, or be spent in a less expensive place than a full soundproof stage.

The second impression is that no substantial saving can be made by improving technical equipment with the object of reducing takes. (Of course there are other good reasons for such improvement, but effort bent in this direction will be ill-rewarded in terms of time saved.)

Limitation of Takes

It is sometimes said that takes should be limited by "front-office instruction." If they were limited to 3 the saving on the floor would be little more than a couple of days in ten or eleven weeks, assuming no other adverse effect on production time which the change might cause. Such an effect might for example be the increase of "dummy takes" between real ones, and the final effect might be to spend more time than is at present spent in shooting on such tentative rehearsals.

The analysis from which these brief notes were extracted also considers the saving of film stock and processing costs if the number of takes is limited. Neither saving is significant compared with production costs.

On the whole, therefore, an attempt to reduce the number of takes per slate in any formal way appears to offer little prospect of great saving. If, however, a personal view may be permitted, it is thought that there is a "perfectionism" in picture making which is costly in many ways: to know when "good enough" is achieved instead of striving for the ideal, especially in mere routine work, might lead to an attitude of

mind which would result in a smaller number of takes per slate (among other things).

3. RETAKES

The Gater committee report says that it is necessary to eliminate expensive retakes. It is not clear whether the committee proposal is that retakes should be eliminated entirely or that the expensive ones only should be stopped. In principle it appears evident that retakes should be discouraged. Production costs could be greatly reduced if no retake is permitted. But production costs alone are not a satisfactory criterion of productional efficiency. If they were, the course of action required of producers would be only too clear. Production costs could be cut in fifty different ways.

More important to the industry is the ratio of quality to production costs. If a bad film can be turned into a good one in a retake period, then retakes are certainly justified.

Analysing Retakes

A survey of retakes has been made. Retakes contain continuous gradations from faithful repetitions of the original take at one end of the scale, to complete rearrangements of scenes or sequences at the other. The latter may not even be shown as retakes in the production records, but marked as entirely new scenes. These rearrangements of scenes are made because the scene as originally shot does not fit well into its sequence or into the whole film. This may be because the mood or tempo is different from the rest of the film, or even because the story is not clear with the scene as it stands, or wrong emphasis is given to some character or some event in the story; or it may simply be that the director's conception of it has matured and he has changed his ideas of how the scene should be shot.

The common factor of these reasons is that the need for the retake becomes evident only when the scene is viewed as a part of a sequence or of the whole film. The scene would appear satisfactory of itself. It is not surprising, therefore, that retakes of this type occur mostly in the later weeks of shooting, and some production units even

schedule a rest period after first shooting of the whole film, followed by a period set aside specially for retakes of this type. These retakes are likely to be the most costly type, since they will more frequently require sets to be rebuilt. It seems very doubtful, however, whether they could be eliminated by any technical device, and indeed whether their elimination would be desirable, playing as they do an important part in the artistic evolution of the film. To simplify the present story, this important group of retakes will be arbitrarily ignored.

There remain those retakes in which the scene is reshot on a separate occasion in substantially its original form. In all those cases there is something unacceptable in the scene viewed solely on its own merits and not in relation to its part in a sequence or in the whole film. Retakes of this sort will usually be decided upon immediately on seeing the rushes, and will be shot at the first convenient opportunity.

There is still some elasticity in the line separating retakes to be considered now from those arbitrarily eliminated, but the number of borderline cases will not be great enough to affect the analysis materially.

The stage work on four films was completed as shown in the table below.

TABLE III
ANALYSIS OF RETAKES

Film A	890 slates plus 73 retakes of which 45 were reshot substantially in their original form, and 28 were of the "rearrangement" type.
Film B	512 slates plus 57 retakes of which 46 were reshot substantially in their original form, and 11 were of the "rearrangement" type.
Film C	491 slates plus 44 retakes of which 15 were reshot substantially in their original form, and 29 were of the "rearrangement" type.
Film D	541 slates plus 39 retakes of which 24 were reshot substantially in their original form, and 15 were of the "rearrangement" type.

Causes of Retakes

Each of the retakes which was reshot substantially in the original form was then

discussed with the Production Manager of the film, who explained why the retakes had been necessary. In this way the retakes were split up according to their causes, as shown in Table IV.

Most of the categories in this table are self-explanatory, except perhaps A and B. The distinction between A and B was preserved by thinking in terms of what new equipment would have avoided the retake. A is meant to include those cases where only greater ability or more experience on the part of the actor would have avoided

shooting of a scene the actors had become exhausted by their repeated attempts to satisfy the director, and the director had, therefore, stopped shooting and ordered a take to be printed because though he was not fully satisfied with the performance achieved he knew he would get nothing better that day. When the scene was retaken the next day or even later, the director and actors approached it with fresh minds and new viewpoints based on the experience gained in their earlier attempts, and a much better take was shot. It is problematical in

TABLE IV
ANALYSIS OF CAUSES OF RETAKES

	Film A	Film B	Film C	Film D
A. Actor performance deficient or action unsatisfactory ...	22	16	21	6
B. Actor saw deficiency in his performance ...	8	16	3	6
C. Director thought he could do better ...		18		
D. Technical effects or composition not what Director wanted (too much rain, inserts wrong size or speed, etc.) ...	11	12		5*
E. Lighting gave wrong mood ...	2			
F. Speech indistinct ...	1			
G. Continuity error, or fault in set discovered after first shooting of the scene ...	1			2
H. Bad Back Projection Plate ...				2
TOTAL ...	45	46	24	15

* one of these was a double exposure trick shot.

the retake. B contains those cases where the actor could appreciate at once on seeing the rushes in what way his performance failed to meet the director's demands, and if it had been possible to show the actor on the floor what his performance would look like on the screen he would have been able to achieve the desired performance at once and the retake would have been avoided.

In practice the distinction between A and B was not as easy to preserve as this explanation might suggest. The view was expressed a number of times by production personnel that at the end of the first day's

how many cases this final acceptable take had of its nature to be approached slowly with the benefit of a night's sleep on the way, and in how many cases an "immediate rush device" would have permitted the successful take to be shot on the first day.

Television Viewfinder and "Rapid Rush Machine"

When this analysis was made the Operational Research team were trying to prepare a "technical balance sheet" for two new devices. The Television Aid was designed to give a television picture having in frame

all that would later be seen on the screen, in correct monochrome rendering; and the Rapid Rush Machine was to process a rush within a minute or so of shooting and subsequently re-screen it on the stage as often as desired. One item on the credit side of both was "to eliminate or reduce retakes" and it was to assess this one claimed advantage (in a mass of others more and less important) that this analysis was made.

It is clear that in its present form the Television Aid could do nothing towards eliminating retakes in categories A and B. If it were fitted with a recording device so

Category D contains the type of retakes which the Television Aid should be specially effective in preventing, and it will be reasonable to assume that all these retakes would be prevented, with the exception of the double-exposure trick shot in Film D, which would require special extra facilities on the Television Aid to display.

The Television Aid should prevent retakes in Category E. It would be ineffective against those in the remaining Categories F, G and H.

The above results are summarised in Table V.

TABLE V
VALUE OF TELEVISION AID AND RAPID RUSH MACHINE—(STAGE WORK ONLY)

Film	Number of Slates	Number of Retakes	Rearrangement type Retakes	Retakes within our definition	Television Aid would have prevented	Rapid Rush Machine or Television Aid with recording device would have prevented x where
A	890	73	28	45	13	$13 \leq x < 43$
B	512	57	11	46	12	$12 \leq x < 46$
C	541	39	15	24	none	$0 \leq x < 24$
D	491	44	29	15	4	$4 \leq x < 10$
Total	2,434	213	83	130	29	

that the take could be played back immediately and as many times as necessary for the benefit of director and actors, then, subject to the limitations imposed by the small size of the screen, it could be regarded as an "immediate rush" device and might, as might also the Rapid Rush Machine, prevent some of the retakes in categories A and B, but certainly not all.

Value of Television Aid

There is an entry under Category C only for Film B, which was this particular director's first film, and these retakes were at the beginning of shooting when he was not very sure of himself. It is possible that the Television Aid might have given him more confidence, but it is impossible to assess how many retakes might have been avoided by its use. The circumstances are in any case rather special.

In round numbers it would appear then that in general rather less than 10% of stage slates are retaken, and between one-half and two-thirds of these are retakes within the terms of the present survey. Of them, the Television Aid would have prevented probably no more than one-quarter. In total, therefore, the Television Aid would have saved something of the order of 1% of the number of stage slates per film.

Value of Play-back Device

A Rapid Rush Machine or a Television Aid fitted with a recording device capable of playing back the take at once and any number of times to the whole of the production unit and the actors might at the best save another 2% or 3% of the total number of slates. It is worth noting that most retakes ascribed to "action" (accounting for most of this extra 2% or 3%) appear to be

decided upon only after discussion and argument amongst the production unit and actors, and after seeing the rushes through several times.

It is certain, therefore, that any recording device fitted to the Television Aid would have to be capable of playing back any number of times, and even then it is problematical how far the small size of the

display might prevent the appreciation of those fine points at present debated on the full-size screen at rushes.

This diffuse survey will have given no clear picture of Operational Research nor of the Technical Objectives in Preplanning. But it may have suggested that objectivity is possible in "operational" problems.

DISCUSSION

Mr. T. S. LYNDON-HAYNES: In your analysis of the possibility of rolling together sequences, was consideration given to the fact that it would probably be necessary to call artistes specially?

THE AUTHOR: A sub-analysis was made to determine whether the cost of calling artistes was compensated for by the shortened production time.

Mr. C. BRUNEL: In the savings contemplated, what proportion might be put down to studio hire, artistes' fees, technicians' salaries, craftsmen's salaries, building charges, etc.?

THE AUTHOR: We took it that there were two major factors that contributed to the cost of a picture: a fixed charge of director's salary, top artistes, and so on, and a charge which goes broadly with the time spent on the floor—some-times including studio hire. You are saving quite a lot if you can save time on the floor, but not proportionately in the whole cost of the film.

Mr. K. GORDON: Has the television viewing device or the rush machine been in active use?

THE AUTHOR: The rapid rush machine has not been in active use. The television aid has in fact been in use in the Rank Studios.

Mr. R. H. CRICKS: It is my opinion that many scenes that are retaken could well have been used in the original form. In rushes, for example, I have seen shots scrapped through fluffs in dialogue, yet such shots seemed more natural than the accepted shot, because they were more natural. People do fluff their lines in real life.

THE AUTHOR: In America, Dr. Gallop invites a standard audience to view a film; the process is

to give the audience a number of handles, and as the audience watches the film the handles are moved in accordance with what they think of the picture. I decided to try it out in this country; if you can get a curve which repeats itself, quite obviously it has something significant. We started off with "Brief Encounter"; with five different factors, we got correlation factors of 0.5 to 0.6, which is the sort of thing you would not get by accident.

Mr. B. HONRI: Over-riding everything is the fact that if the story is good, technical faults are not noticed; the worse the picture, the more do technical defects appear. When you add together all the factors, you have the difference between a first feature and a joint first feature—a difference of four times the income on the picture.

Mr. C. TOMRLEY: In plotting these statistics, do you make allowance for faults which are afterwards corrected by opticals?

THE AUTHOR: Allowance was already made for "dodges."

Mr. ALAN: Was it your Operational Research organisation that arrived at the basic theories on which Independent Frame production was undertaken? If so, have you since analysed the practical results?

THE AUTHOR: No, we did not design the Independent Frame method. There is a lot of good in the process, but there were too many things tried under one heading; those that were good were submerged in those that were not, and the total result was that I.F. was not so much less costly than other methods of picture making.

A COURSE OF LECTURES ON SENSITOMETRY

A course of lectures on Sensitometry will commence on February 26, 1951, to be given by Mr. I. B. M. Lomas, A.R.P.S.

The lectures will take place at Kay's (West End) Theatre, Movietone House, 22 Soho Square, W.1, on Mondays, at 7.30 p.m., as follows:—

February 6, 1951.—"Early Work in the Field of Photography."

Brief survey of the most important contributions to photography during the last hundred years. Detailed examination of the pioneer work of Hurter and Driffeld.

March 5, 1951.—"Sensitometers and Densitometers."

Intensity-scale and time-scale sensitometers.

Constant light sources. The Eastman IIB sensitometer. Grease-spot photometers; comparative wedge densitometers; polarization photometer; photo-electric densitometers.

March 12, 1951.—"Characteristic Curves and Developers."

D/log E curves; the effect of exposure; reversal effects; gamma-infinity. Negative and positive developers; effects of each component in a developer and examination of some of the problems encountered.

March 19, 1951.—"Sensitivity of an Emulsion."

Various accepted methods of speed determination and their shortcomings. The importance of knowing the spectral emission of light sources used

in sensitometry. Determination of colour sensitivity of an emulsion.

April 9, 1951, and April 16, 1951.—"The IIB Sensitometer applied to Laboratory Control Work."

Comparative tests on negative material. Control of typical negative developers. Problems encountered in master and dupe printing. Grading negatives. Comparative tests on positive stocks.

Latent image fading. Positive developer control problems. Developer replenishers. Relating sensitometer and printer. Printer gamma and response. Long-term control in minimizing process drift.

The British Kinematograph Society desires to express its appreciation to Messrs. Kay (West End) Laboratories for their courtesy in permitting these lectures to be given at Movietone House.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted can be seen in the Society's Library

THE BIRTH OF KINEMATOGRAPHY

Ideal Kinema, May, 1950, p. 25.

Following reference to the paper by the present abstractor on the work of Friese-Greene (*Brit. Kine.*, 16, No. 5, May, 1950, p. 156), a decision of an American court is quoted, denying claims made on behalf of Edison as the inventor of cinematography.

R. H. C.

A METHOD AND APPARATUS FOR TESTING THE DEVELOPMENT PROCESS

L. Busch, *Foto-Kino-Technik*, May, 1950, p. 150.

In a system of sensitometric control, a simple pendulum sensitometer impresses two exposures on a strip of film. The densities of the two images are ultimately scanned by twin photo-cells in a desitometer, which reads off the differential as a contrast value.

G. I. P. L.

SURVEY OF HIGH-SPEED MOTION PICTURE PHOTOGRAPHY

K. Shaftan, *J. Soc. Mot. Pic. & Telev. Eng.*, May, 1950, p. 603.

A survey of high-speed motion picture practices was conducted by the Society in 1949. The data collected are presented here, with a review of comments submitted by users of high-speed techniques and equipment. Conclusions are drawn by the author regarding the current availability of such information and also the scope of the survey is commented upon. Recommendations are made concerning the future of photographic instrumentation and the rôle of the Society in this expanding field.

AUTHOR'S ABSTRACT.

PRINTING EXPOSURE DETERMINATION BY PHOTO-ELECTRIC METHODS

L. E. Varden and P. Krause, *American Annual of Photography*, 1950.

Following a review of past work on the automatic control of printing exposure, three principles are considered: photometer measurements of selected density areas; integration systems without coding; and integration systems with coding, in the last the photometric integration being modified by a coding indicating the density distribution in the image.

R. H. C.

50% ECONOMY IN PRINTING COSTS

R. Colas, *Film Français*, Spring 1950, p. 86.

A normal 35 mm. film base carries two sets of picture frames, each frame 12 mm. x 9 mm., and two sound tracks. In the first projection alternate frames and one sound track are reproduced; the film is then re-threaded without rewinding, and the second set of frames and the second track reproduced.

R. H. C.

OPTICOLOR PROCESS OF COLOUR KINEMATOGRAPHY

G. Lechesne, *Tech. Ciné.*, April, 1950, p. 95.

In the revived Opticolor process, the negative carries trichromatic sets, each separation image occupying a normal frame, and the negative thus travelling at three times normal speed. It is printed upon a lenticular positive.

In the camera developed for the process, a beam-splitter optical system is used, with variable-focus objectives. The reflex viewing system employs a polished spherical face on the shutter.

R. H. C.

PHOTOGRAPHIC SOUND RECORDING ON 16 mm. FILM

N. Leever, *Sound Recording*, 3, No. 6, 1950, p. 120.

The photographic factors governing 16 mm. recording technique are described in some detail, and recording procedures for direct positive, neg-pos, reversal, and Kodachrome outlined and compared.

AUTHOR'S ABSTRACT.

SOUND RECORDING IN FRENCH FILM PRODUCTION

Le Technicien du Film, 2, No. 6, 1950, p. 9.

A committee appointed by the Commission Supérieure Technique reports on a number of faults in French

sound recording, notably the diction of artistes, recording and mixing levels, masking of speech by music, and sensitometric aspects.

R. H. C.

MAGNETIC RECORDING IN MOTION PICTURES

Audio Eng., March and April, 1950, pp. 9 and 18.

Fundamentals and theory of magnetic recording with H.F. bias are briefly reviewed. Details with tables and curves are then given of ring head construction, characteristics and parameters. Finally, the factors governed by bias current are examined and noise sources tabulated.

N. L.

THE COUNCIL

Summary of meeting held on Wednesday, December 6, 1950, at 164, Shaftesbury Avenue, W.C.2

Present: Mr. A. W. Watkins (*President*), in the Chair, and Messrs. L. Knopp (*Vice-President*), H. S. Hind (*Hon. Treasurer*), D. Cantlay, B. Honri, T. W. Howard, N. Leever, R. E. Pulman, S. A. Stevens, I. D. Wratten, R. J. T. Brown (*representing Papers Sub-Committee*).

In Attendance: Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. F. G. Gunn, W. M. Harcourt and E. Oram.

The President.—The Council learned with regret that Mr. A. W. Watkins was about to undergo treatment at King's College Hospital which was likely to incapacitate him for some time. He asked to be relieved of his office for the present.

COMMITTEE REPORTS

Sub-Standard Film Division.—The recommendation that the title of the Division be changed to "16 mm. Film Division" was approved. Reports were received from the Chairmen of the Technical Sub-Committees engaged in the 16 mm. Film Investigation.

Difficulties had arisen concerning the constitution and terms of reference of the Photographic Sub-Committee and these were being considered. The Sound Sub-Committee was at present engaged with work concerning frequency characteristics, and the Projection Sub-Committee was carrying out preliminary work in compiling data concerning projectors.

Common agreement had been reached that recommendations which were made must be based on the assumption that the apparatus and methods are the best available.—*Report received and adopted.*

Theatre Division.—The demonstration of large screen television at the Odeon, Penge, had been deferred for the present, but two interesting fixtures arranged in the programme for the remainder of the Session were first, a Brains Trust on February 11, when Dr. Leslie Knopp would be the Question Master; and second, a visit to the Festival of Britain Telekinema on April 8, which would be open to all members of the Society.

Matters concerning the suggested new proposal and transfer form were discussed. In regard to the annual elections, the following recommendation was submitted for approval:

"That the names of electors should in

future be omitted from the ballot papers and appear only on the back of the envelope containing the ballot paper."—*Report received and adopted.*

Film Production Division.—Papers for the remainder of the Session had been arranged.

The excellent response to the Course on "Lighting for Kinematography" had been noted with satisfaction, and the following recommendation was submitted for approval:

"That the lectures should be published in book form."

A matter considered to be of great importance was the number of papers in the session for which the Division was responsible. The decision was reached that in the 1951/52 Session the number should be reduced from ten to seven.

It was highly probable that the studio visit this year would be arranged to take place at Lime Grove Studios.—*Report received and adopted.*

Journal and Papers Committee.—In order that the Journal Sub-Committee be more suitably constituted to select the contents for the Journal, the terms of reference were amended to read:

"The Journal Sub-Committee will be responsible to the Journal and Papers Committee for the month to month administrative work in connection with the Journal and the selection of the contents. In this work, it may call upon the assistance of a panel of referees composed of members of the Society."

A number of improvements to the Journal were being considered and the following *ad hoc* Committee had been appointed to decide the details: Messrs. N. Leever, H. S. Hind, R. J. T. Brown and G. Parr.

In the interests of maintaining the high quality of papers read to the Society, it was considered that the number of meetings in the 1951/52 session should be decreased. The Papers Sub-Committee would, however, consider this matter further in due course.—*Report received and adopted.*

N.A.T.K.E.—The request received from N.A.T.K.E. to publish the brochures compiled by the Film Mutilation Brochure Committee was referred to the Theatre Division for consideration.

Patron Member.—Messrs. Oldham & Son, Ltd., had become a Patron Member of the Society.

The proceedings then terminated.

BOOK REVIEW

Books reviewed may be seen in the Society's Library

SPOTLIGHT ON FILMS. By Egon Larsen.
Max Parrish & Co., Ltd. 15s. net.

The newcomer to film production, the serious amateur kinematographer and those engaged in other branches of the industry, will find much to interest them in this book, and to acquaint them with the mechanics and techniques of the studio.

That Ealing is used as the yardstick I find far from a disadvantage, as this studio is known throughout the industry as well run, economic and efficient. So although other organisations have equally good methods and differ slightly from time to time, we shall have no serious quarrel with the production procedures outlined. The book starts with an historical introduction, proceeds to a very

thorough breakdown of production matters, profusely illustrated, and ends with a chapter called "You and the Film."

Egon Larsen is not apparently pro-American, as Hollywood comes in for some rough handling. We learn about some interesting features of U.S.S.R. methods.

"Spotlight on Films" concludes with a glossary of technical terms. The purist will argue about some of its definitions, but in the main there is little with which to disagree. All in all, one can recommend the book, and it should find a place as a reference book on the procedures of film production.

T. S. LYNDON-HAYNES.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography

G. W. ASHTON and B. HONRI have been elected Associate members of the Royal Photographic Society.

P. H. BASTIE, a founder member of the Society, and for many years Hon. Treasurer, attained his eightieth birthday on January 19.

A. P. CASTELLAIN is in hospital due to heart trouble.

A. CHALLINOR is in charge of the combined home and export department of G. B. Kalee, Ltd.

H. E. DANCE, of the Ministry of Education, has been transferred to staff inspector of engineering.

W. B. DEAN is leaving the Brookfield Cinema, Poynton, and plans to live in North Wales in semi-retirement.

F. A. HOARE has been appointed one of the three new Governors of the British Film Institute.

K. B. HARTLEY has been re-elected Hon. Treasurer of the Kine. Section of the Royal Photograph Society.

REX B. HARTLEY is in charge of the newly formed Motion Picture Section of the G.E.C.

R. LIDDELL has become Chief Engineer at Columbia Ribbon and Carbon Manufacturing Co., Ltd.

CHARLES VINTEN has just returned from a business trip to South Africa.

The following deaths are noted with regret:

FRANK ALEXANDER BEAKE (Associate)

OLIVER GLOVER (Member)

ALBERT HENRY ROSS (Member)

FRANCIS ALEXANDER THOMASSIN
(Associate)

DINNER DANCE

Members who desire to attend the Dinner-dance taking place at Grosvenor House, Park Lane, on Wednesday, April 4th, should apply for tickets, price 37s. 6d. each, as soon as possible.

PERSONAL ANNOUNCEMENT

Required, Sound Engineer, thoroughly conversant in 35 mm. and 16 mm. equipment, installations and repairs, etc., to take a lucrative job in India for a well-established concern importing American and Continental Projection Equipments. Apply Box 6068, The British Kinematograph Society, 117, Piccadilly, London, W.1.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than situations Vacant, not accepted.

BRITISH KINEMATOGRAPHY

Your last year's copies of this Journal (Volume 16 and 17) can be bound in blue cloth with gilt lettering, price

17s. 6d.

A limited number of bound volumes for 1949 (Volumes 14 and 15) are still in stock, and bound volumes for 1950 (Volumes 16 and 17) will be available, price

£2 12s. 6d.

BRITISH KINEMATOGRAPHY

VOLUME 18, No. 2

FEBRUARY, 1951

DO YOU USE YOUR LIBRARY?

The B.K.S. Library consists of some five hundred volumes which cover every facet of cinematography from the purely technical to the cultural, as well as trade and technical periodicals from many countries. At Dean Street, in the heart of the Film Industry, the library well patronised and often at lunch times and in early evening was very popular.

Our compulsory move to the far end of Piccadilly has caused a marked falling off in the number of callers and it is felt that more use could be made of the postal facilities offered.

Many new books have been added to the library since the catalogue was printed and it is intended to produce a new edition very soon. Meanwhile we hope that many of our members will take advantage of this right of membership - a postcard to the Librarian at 117 Piccadilly will bring any volume on our lists to your doorstep by return of post. And if you ask for something worthwhile which is not in the library, it will be regarded by the Library Committee as a strong hint that it should be purchased without delay!

R. J. T. BROWN.
Chairman, Library Committee.

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ECONOMIC ASPECTS OF STUDIO LIGHTING

Read to the Film Production Division on December 20, 1950.

I. SERIES-PARALLEL WIRING OF ARCS

C. W. Hillyer (Member)*

SERIES running of production lighting equipment is not new as such, but has usually been associated with the operation of 115v. equipment on 240/400 volts. This, of course, has been in regular use for years in natural interiors, and is usually part and parcel of the routine of documentary and shorts units. The system now to be considered was brought to notice by the marketing by the General Electric Company of an H.I. arc designed for series running, one of its main features being that it used the whole of the line voltage instead of only 60 volts as in the ordinary system.¹

My first experience of any size of running the standard M.R. Type 170 150-amp. H.I. arc² in pairs without grids was at Isleworth in the winter of 1947. The large stage was filled with a set depicting a Scottish Moorland, and we were in process of lighting the Battle of Prestonpans, which constituted a track shot from a crane the full length of the studio. The film was in Technicolor and the lighting involved about 14,000 amps., the lighting equipment being in the main M.R. Type 170 arcs, with G.E.C. twin arcs in series for cloud glasses. Of the 14,000 amps., 5,000 was from the studio power house and 9,000 from mobile generators.

Development of Series Burning

It was not surprising that many power troubles occurred. Very opportunely, we were offered six pairs of connectors for running pairs of M.R. Type 170 arcs in series without grids. After a ten minutes' test, connectors were cut from head extensions, wires were bared, and all the arcs were being wired in series.

It was early obvious that the foot candles per lamp had dropped considerably, and that synchronised striking and adjusting of arc gaps was necessary to keep the lamps

alight. Having mastered this, the set was re-balanced, and we finally shot long shots of different types and lighting for three days on this rig.

Laboratory research was continued into series-parallel burning, and its possibilities were realised quickly by some smaller industrial and documentary units—in fact, one unit works almost all the time in series-parallel from mobile generators.

Some 2½ years later Mole-Richardson's Research Department demonstrated series burning of two arcs with practically no loss of foot candles per lamp; in fact, 150 amps. on one lamp with grid, gave exactly half the light of 150 amps. on two lamps connected in series. With auto-striking also demonstrated one felt that real progress was there, but there still remained the wasteful and annoying business of running two arcs if only one was needed.

The "Mole Float"

In March, 1950, at the request of the Lighting Committee of the British Film Producers' Association, arrangements were made for a large-scale demonstration of series-burning equipment.³ Sixty M.R. Type 170 arcs were wired in series-parallel, by means of a five-wire circuit embodying what was named the "Mole float" (Figs. 1, 2 and 3.)

After discussing the demonstration, the Committee agreed that the system was practical: there was no loss of foot candles per individual lamp; the current loading, power consumption and cabling were halved; and that its immediate application was on location and natural interiors. Many studios purchased a few carbons for experimental use.

Series-parallel running

Series-parallel running was tested on location in Spain (on Technicolor) and in South

* British Lion Studio Co. Ltd.

Africa. The former unit made use of the system on six occasions; the latter unit reported that the saving in time and labour (due to the reduction in cabling and to dispensing with resistors), and also in current—about one-third reduction—was such that lighting rigs, so far as M.R. Type 170 arcs were concerned, were always planned in pairs. However, neither unit made use of the "Mole float," and results were inconclusive.

twin arcs. Allowing for diversity factors it was considered that the power house rated output of 32,000 amps. could cope. The stage is installed for 12,000 amps. with a main breaker distributing to twelve 600 amp. gantry panels and two 6,000 amp. floor panels, the whole system being 3-wire, 240v. across outers.

However, it early became apparent that the whole industry could not produce

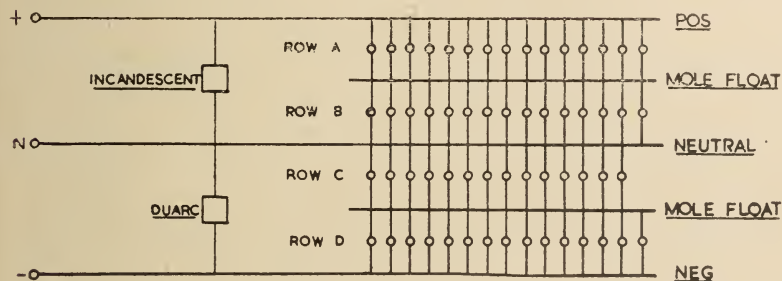
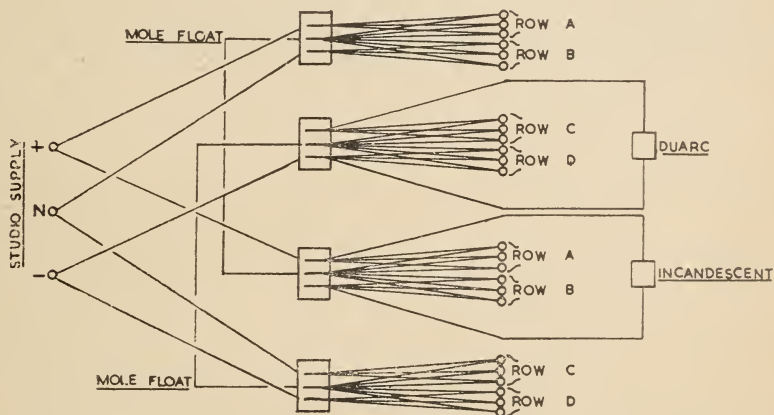


Fig. 1. Theoretical Circuit for series-parallel running. 59 M.R. Type 170 arcs in series-parallel, 1 incandescent and 2 "Duarcs" in parallel.

Fig. 2. Practical Circuit of Fig. 3. Connections were made by means of 3-way Boxes.



Large-scale Test

Coming now to September last, the third act of "Tales of Hoffman" was to be filmed in a set of the Music Room; 45 minutes of finished cut film had to be shot in eight days. For this huge set the lighting rig called for some 35,650 amps., and was made up of 176 Type 170 150-amp. H.I. arcs, 6 Type 1450 "Brutes,"⁴ 100 Type 40 "Duarcs,"² and 26 G.E.C. 150 amp. H.I.

enough cable to enable us to carry the current required from the power house to the stage and then distribute it inside. There were obviously only two alternatives: reduce the size of set or make use of series running using the "Mole float."

It was at this stage that we learned that at Beaconsfield the "Mole float" was in use, which puts the Crown Film Unit as the first people actually to use this system, al-

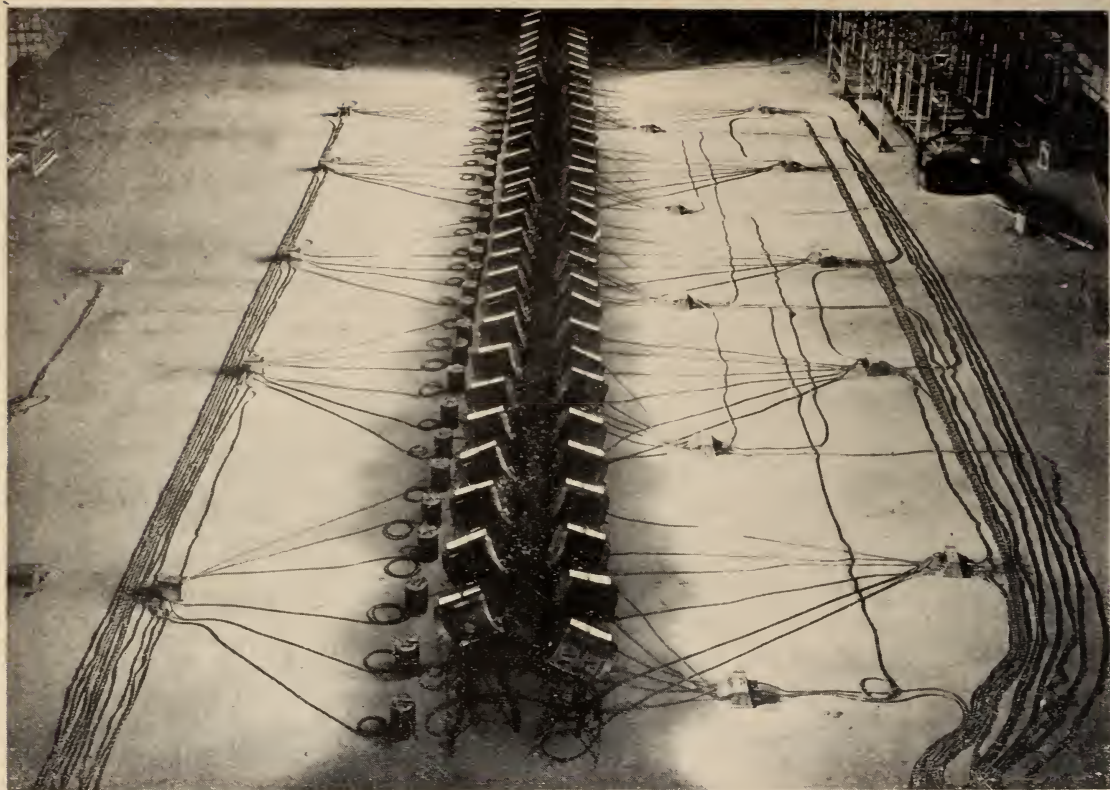


Fig. 3. Sixty M.R. Type 170 Arc Lamps assembled for Test at Shepperton Studio, embodying a Five-wire Circuit employing the "Mole float."

though their load was restricted to twenty Type 170's.

The plan finally settled on was to wire 132 Type 170 150-amp. H.I. arcs in series-parallel, using the "Mole float," 26 G.E.C. 150-amp. H.I. twin arcs, 6 Type 1450 "Brutes," and all the "Duarcs" and the balance of the Type 170 H.I. arcs on the outs. In former demonstrations of series burning protection gear was dispensed with, but I insisted that every six arcs had a fuse protection. At this stage this did not complicate the problem, as each 600-amp. circuit was switched and fused and the whole of the series equipment was connected to the silent stage permanent wiring.

The speaker described in amusing fashion the problems of wiring this quantity of equipment. He continued:

The next difficulty was that the photographer was in the habit of setting his key

light first, and then lighting his sets. Under this system, and until a balance is obtained (which is only a matter of seconds but has to be done continuously) the amount of light is bound to vary as the voltage across the arcs goes up or down.⁵

Balancing the Loads

With experience this variation was almost eliminated by the controlling electrician lighting or "killing" an arc to bring the whole circuit into balance. From observation, it seemed he chose a position on the rigging (after seeing the extent of the camera angle) and used two to six arcs not in use on that particular shot for starting and balancing purposes, balancing entirely by eye and the colour of the arcs, having in front of him a drawing so that he could see at a glance which lamps were on which side.

The conclusion from the photographer and the "gaffer" at the end of two days'



Fig. 4. Part of the Music Room Set for "The Tales of Hoffman." The Lighting Rig called for over 35,000 amps.

Courtesy of London Film Productions Ltd.

shooting was that "It was a little tricky, but O.K." The power house recording charts showed considerable economy.

The control electrician suggested that if we could instal an out-of-balance meter in the "Mole float" he could keep a very accurate balance even under the worst conditions. We learnt that actually such a meter had been included in the original design of the system, and a meter already existed. This was soon installed, and it then became an extremely simple matter to keep the "Mole float" accurately balanced, as after a little experience one could tell exactly what correction needed applying, by noting how far the meter moved.

Economic Advantages

As with most extremely large sets, the maximum loads were seldom reached. On the day when the greatest demand was made on the equipment, lighting was commenced in the morning; later the lighting was completed with stand-ins, the full loading by

ordinary rating being 22,000-amps., reduced by series-parallel burning to 16,000-amps. Following 75 minutes' rehearsal with working lights, rehearsal with full lighting occupied 14 minutes. The actual shooting occupied 15 minutes, and still photography a further 12. Several other set-ups were filmed on the same day.

The saving in electricity was £8 3s. (or 31%) on the one shot described, but for a studio solely dependent on public supply and operating on maximum demand charges the saving would have been £2,770.

With these facts I suggest this system has been proved and satisfies economic requirements. My only suggestion, to make it as effective as ordinary circuits, is to employ good electricians and own plenty of .2 cable.

When considering lighting rigs for night exteriors, photographers may well give consideration to the use of this system, as intelligent placing of lamps will reduce the number of mobile generators in use, reduce the cost, and make twice the light available.

II. ECONOMICS OF THE FIVE-WIRE CIRCUIT

C. G. Heys Hallett, M.A., A.I.P.E. (Member)*

THE previous paper establishes beyond doubt that series running is now a practical proposition on any size of set, and much value can be obtained from a study of the difficulties encountered.

The set in question represented the most complicated cabling which can be encountered. The studio has a 3-wire system, and it was required to mix large numbers of lights in series-parallel with others running in parallel, many being fed from 600 amp.

sisted of generators connected in series, supplying 600 amp. gantry panels. Now suppose that half the generators were removed, the remainder connected across the outers and the neutral disconnected. If the set is now cabled up, using all the standard 3-wire cables and boxes, the only variation from normal practice which will be required is as follows: All lights requiring 115 volts, such as incandescents and "Duarcs," are connected across the outer bars of the con-

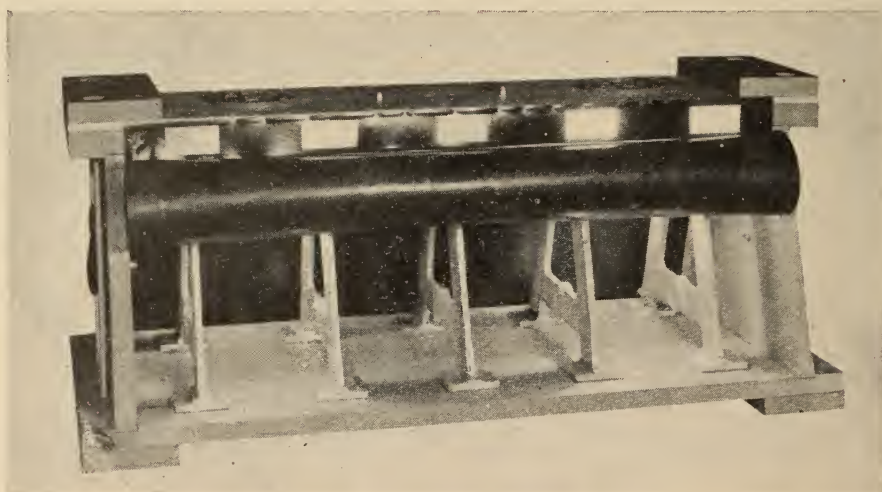


Fig. 5. Five-wire Connecting Box for use with "Mole Float."

gantry panels. The "Mole float" must, of course, be continuous throughout the set, and considerable thought was, therefore, necessary while connecting it up between circuits. On a two-wire system it is necessary to watch the balance of the "Mole float" in relation to the positive and negative, but on a 3-wire system, it is not only necessary to watch the balance of two "Mole floats," but also to watch the out-of-balance current in the neutral, so the 3-wire system is at least three times as complicated.

How simple large scale series running could be is indicated by the following analogy: Suppose that a 3-wire system con-

necting boxes, while arcs to be run in series are connected, without grids, between an outer and the centre bar; what was the studio neutral bus-bar is now providing most of the "Mole float," and the remainder will consist of what would otherwise be regarded as normal 3-wire cable runs.

Adaptation of 3-wire System

For studios which already have a 3-wire system, it is possible that cabling would be much simplified by the use of a 5-wire connecting box (Fig 5). This type is fitted with work lights which also operate as polarity indicators.

* Mole-Richardson (England) Ltd.

TABLE I
COST OF OPERATING SPOTLIGHTS

Lamp Type	Relative Illumination f.c.	Operating cost in shillings				Total cost per hr. for equal illumination
		Carbons or Bulb	Current	Labour	Total Cost per hr.	
MR 170 series ...	100	2.45	4.1	1.75	8.3	8.3
MR 170 parallel ...	100	3.35	7.85	1.75	12.95	12.95
MR 1450 series ...	130	2.45	4.1	1.75	8.3	6.4
MR 1450 parallel ...	280	7.0	11.9	1.75	20.5	7.35
MR 414 — M.P. ...	36	3	2.3	0.3	5.6	15.6
MR 414 — C.P. ...	42	12	2.3	0.3	14.6	34.7
MR 410 — M.P. ...	11	0.4	0.9	0.3	1.6	14.5
MR 410 — C.P. ...	14.5	5.7	0.9	0.3	6.9	47.8
MR X 6	1040				53	5.1

The control of the set was, as you have heard, greatly assisted by a meter which indicated directly the balance of the two "Mole floats." A number of meters with 6 in. dials are now available.

The previous speaker stated that he had employed spare arcs for balancing purposes. These, however, require carbons and attention, and arc grids connected in series would be preferable. An automatic balancer has now been produced (Fig. 6) which will automatically switch arc grids in and out to rectify an out-of-balance not exceeding 600 amps. on either side.

The effect on location shots will also be great because series-parallel running enables up to $2\frac{1}{2}$ times as much light to be obtained from a given generator. On occasions this will result in considerable economy, but it

will greatly increase the scope of shooting on location, and sets hitherto regarded as impracticable or prohibitively expensive, will come well within the bounds of possibility.

Relative Economy of Light Sources

It is now instructive to consider the relative performance of the several types of lights in regular use.

Table I shows the relative power of the principal types of spotlights, the running cost per lamp, and, in the last column, the running cost for equal light on the set, the M.R. Type 170 150-amp. arc² being taken as the standard. It will be seen that series running has a remarkable effect on the cost of running the 150-amp. arc, but that the M.R. Type 1450 ("The Brute")⁴ is the most economical light source.

TABLE II
COST OF OPERATING FLOODLIGHTS

Lamp Type	Relative Illumination f.c.	Operating cost in shillings				Total cost per hr. for equal illumination
		Carbons or Bulb	Current	Labour	Total Cost per hr.	
"Duarc" ...	100	2.5	2.2	0.45	5.15	5.15
Skypan M.P. ...	200	6.0	2.3	0.3	8.6	4.3
5 kW. Compact Source	180	3.5	3.8	0.3	7.6	4.2
Single light can ...	13	0.016	0.45	0.3	0.75	5.9
Double light can ..	31	0.032	0.9	0.3	1.2	3.95

Table II shows the relative economy of the principal floodlights, but in this case the "Duarc,"² which is taken as the standard, consists of two arcs in series; it is highly efficient, and no comparable improvement in efficiency is possible.

TABLE III
"PANDORA AND THE FLYING DUTCHMAN"—
PROFESSOR'S STUDY

Lamps Rigged	Current
3 — 5 kW. Compact source floodlights	210
32 — 2½ kW. Compact source floodlights	1120
2 — 225A. H.I. Arc spots ...	450
56 — 150A. H.I. Arc spots ...	8400
3 — 120A. H.I. Arc spots ...	360
2 — 65A. H.I. Arc spots ...	130
32 — 40A. H.I. Arc spots ...	1280
4 — 5 kW. incandescent spots	170
4 — 2 kW. incandescent spots	70
4 — 500w. incandescent spots	20
2 — 500w. incandescent floods	10
<u>147</u>	<u>12,220 amps.</u>
Cost of rigging lamps, cabling up and striking	8%
Spot rail construction ...	5%
Labour for operating lamps	33%
Power used, 15,030 kwh @ 5.6d. per kwh ...	29%
Cost of bulbs and carbons	25%
	<u>100%</u>
No. of days	8
Total Burning time ...	30 hrs.

Cost of Lighting a Set

It is now necessary to show the relative importance of the various components of the cost of lighting a set, and the Professor's Study from "Pandora" has been studied for this purpose, with the result shown in Table III. It will be seen that the set is of about average size, and representative of current

practice. The cost of rigging the lighting, and removing it all afterwards, amounted to 13% of the total cost, while the other three factors are of about equal importance.

Table IV shows the lighting of this set as rigged. It will be seen that it comprised

TABLE IV
"THE RED SHOES" (BALLET SCENE)

Lamp	As Shot	
	Quantity	Current
Effect Spot	1	300
M.R. type 1450 ("Brute") In parallel	2	450
M.R. type 170 In parallel		
At 200 amps. ...	12	2400
At 150 amps. ...	71	10650
M.R. type 90 In parallel	8	960
M.R. type 65	3	195
M.R. type 40 & 27 Twin Arc Floods	121	4840
Incandescent Spots ...	13	210
Total	231	20005

231 lights, having a total connected load of 20,000 amps. The choice of lights for a set depends on many factors besides that of economy. The first requirement is, of course, the perfect photographic result and everything must be subordinated to this end; but it is none the less instructive to consider what economies could be made.

Choice of Equipment

The main lighting consisted of 83 M.R. Type 170 arcs, 12 of which were over-run at 200 amps. The same total light output

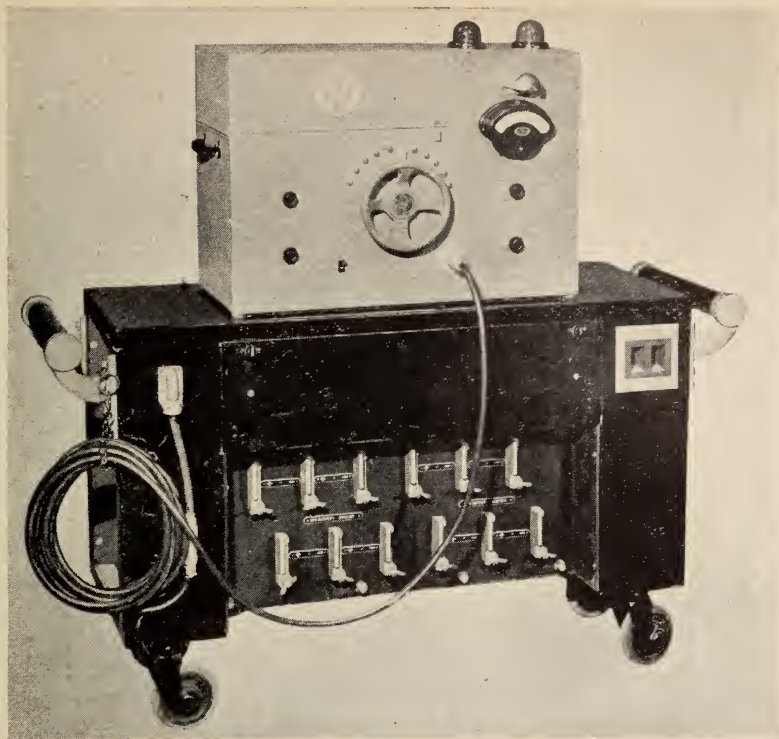


Fig. 6. Automatic Balancer and Resistance Unit.

could have been obtained by any of the following arrangements:

- 1. 88 Type 170 run in series-parallel.
- 2. 31 Type 1450 ("Brutes") in parallel.
- 3. 60 Type 1450 ("Brutes") in series-parallel.

The 121 "Duarcs" and twin arcs have been replaced by 68 M.R. Type 461 5-Kw Compact Source Floods ("Dumbo")⁶ and, as in this scene no "Duarc" was used singly, there can be no doubt about the desirability of the change.

The selection of the alternative spots will,

of course, depend on the needs of the lighting cameraman as regards the number and relative power of lights, and he would probably use a combination of two or all three systems. Assuming that the total lighting cost is proportioned as in Table III, the adoption of "Dumbo" in combination with the above equipment would have the results shown in Table V.

It will be seen that the potential saving ranges from a minimum of 27% to a maximum of 44%, and there should therefore be no difficulty in obtaining an actual saving

TABLE V
POSSIBLE LIGHTING RIGS FOR "RED SHOES" SCENE

	Total Lights	Current	Cost
As Shot	231	20,005	100
68 "Dumbos" + 88 M.R. Type 170 in series-parallel ...	177	12,985	73
68 " + 31 M.R. Type 1450 in series ...	120	13,385	56
68 " + 60 M.R. Type 1450 in series-parallel ...	149	11,905	63

of one-third without in any way embarrassing the lighting cameraman.

Cost of Providing and Maintaining Lights

It is instructive to consider the effect on a studio if such a change in practice were well established and were applied to all films.

The studio would need, for the service of all its stages, a greatly reduced number of arcs, and only a proportion of them need be equipped with ballast resistors, while there would be a saving of about 40% on the total amount of cable required.

The time taken completely to overhaul an H.I. arc spot is about 13 hours and does not vary much from one size to another; the reduction in the total number of arcs required by a studio would, therefore, effect a substantial saving in maintenance.

There are other economies, over and above this, which can be effected by the latest equipment. Due to the burning hours counter, arcs may be overhauled after a predetermined amount of use, thereby increasing their reliability, reducing troubles on the set and eliminating unnecessary work. The demountable mechanism considerably reduces the overall cost of overhaul and will also enable the mechanism to be kept cleaner. Other features in the latest designs include the following:

1. Visible warning 13 minutes before carbons must be changed and the ability to do so in 20 seconds without disturbing the setting of the lamp; also the ability to change the complete mechanism in 30 seconds.
2. Arc image periscope to ensure correct setting and silent steady burning.
3. Polarity indicator to assist cabling and to prevent delays due to damaged craters.

These factors will tend to reduce delays during shooting, but no data are available to enable the average saving to be estimated.

Future Developments

In addition to showing the benefits which are now available by the adoption of the recent developments which have been discussed, the data also contain some indication as to the future trend of development.

Table I shows the trend in arc development and the increased economy of the more powerful lights. Finality has by no means

been reached, and the next arc which will be made available as soon as there is a demand for it is the Mole-Richardson Type X6, the performance of which is indicated at the foot of the table. It will be seen that its efficiency, as measured by its cost of operation for equal light output, is considerably better than that of the present largest arc. A spot of this enormous power, equal to some ten 150-amp. arcs, will probably be too powerful for widespread use on the average studio set, but may be of great value on the largest sets and also on location. The economy due to series running is, in a sense, fortuitous, because it arises from the fact that 115 volts is an inefficient supply voltage for the smaller arcs and results in undue loss in the ballast resistance. Though finality has not been reached in the development of arcs, as evidenced by the Type X6, there is no probability, as far as can be seen at the moment, of a comparable advance with other types of light source.

The estimates which have been discussed cannot be exact, but their probable error is small compared to the economies which can be expected. It is apparent that relatively little capital expenditure will be required in order to obtain the full benefit of these modern developments.

Influence on Studio Design

The influence of series-parallel running on the design of future studios is worthy of discussion. The "Mole float," the practicability of which has been demonstrated tonight, may be regarded as a simple expedient for the conversion of a 115 volt circuit to a 3-wire system, with 115 volts across the outers and $57\frac{1}{2}$ volts between outers and "Mole float," but, as the "Mole float" is not connected to the generators, balance can be maintained only by controlling the load. This is not particularly difficult, because experience has shown that an out-of-balance not exceeding 10% causes no ill effects. This raises the question whether, when a new studio is being designed, it would not be wiser to install a normal 3-wire system, but with $115/57\frac{1}{2}$



Fig. 7. "The Professor's Study," from "Pandora and the Flying Dutchman."

Courtesy of Romulus Pictures Ltd.

volts instead of 230/115 volts.

Series running has hitherto only been used on location as a convenient economy, but it has great possibilities in this direction which are worthy of attention in the preparation of a script. The fact that up to $2\frac{1}{2}$ times as much light can be obtained from existing generators should enable the scope of this type of shot to be greatly increased by the inclusion of long-shots which have hitherto been considered impracticable. The façade and forecourt of Buckingham Palace may be taken as an example; the frontage is

350 ft. long by 90 ft. high. Under present conditions the M.R. 1400-amp. generator can burn nine 150-amp. arcs which would probably be just sufficient to light a procession and the archway through which it passes; but employing these modern developments, the same generator could provide $2\frac{1}{2}$ times as much light, which would give an average of 160 ft.-candles over the complete façade and forecourt.

It is to be hoped that those who put these suggestions into practice will come forward and describe their experiences to the Society.

III. IMPROVED STUDIO FACILITIES

Jack Cardiff, A.S.C., B.S.C.*

PRIOR to photographing "The Red Shoes," I visited Hollywood for three months. During that visit, I saw with astonishment their methods and wonderful equipment, which help to make film making so easy and time saving. Musical produc-

tions were being made, and large numbers of arcs, dimming with finger-tip control, were being employed. The many things seen I noted in a long report, but what was most impressive was that each department was always trying to cut down time in the

* Festival Film Productions Ltd.

use of their equipment.

Since I returned, many of these devices and ideas have been used in British studios. Mole-Richardson, Ltd., have taken full advantage of cordial relations with American colleagues, and have made many of these ideas—for example, the remotely controlled shutter dimmers—available in England; but, perhaps more important, they have produced many original improvements on existing designs and also entirely new and time saving lights.

Larger Lighting Units

When "The Red Shoes" was started, I was able to include in the lighting equipment many American ideas. Two Mole-Richardson "Brutes" were flown over in time. They were used on every shot of the ballet sequence, and were invaluable. Many more were needed on large stage sets, where each lamp had such a long throw. One 150-amp. arc had to be "spotted up" so much to obtain the required intensity of light, that it covered only a two-foot diameter spot. In order, therefore, to high-light a large section of the set, twelve or more lamps would be required, where only a few "Brutes" would have been necessary.

This was the case when lighting the church set in the ballet sequence. Because the lamps were spotted to such a small diameter, adjustment was most delicate. In order to

trim and change carbons, it was necessary to swing each lamp off its finely set position, and so every lamp had to be frequently reset. Thanks to the new design, whereby the back instead of the side of the lamp is opened when trimming, the hold-ups previously experienced have now been eliminated.

Another time-saving innovation is the use of fewer but more powerful lamp units. The time saved in trimming is considerable. Although no production figures are obtainable, it will be agreed that trimming 31 "Brutes" instead of 83 150-amp. arcs does save time. The difficulty in getting a broad lighting effect with so many small lights was great, and had more "Brutes" been available, much time could have been saved and the lighting made more effective. The new lamp, the X6, will be of the greatest value in studio work.

A reel of the ballet sequence from "The Red Shoes" was projected.

Acknowledgments

The authors gratefully acknowledge the valuable assistance of the experimental staff of Mole-Richardson (England), Ltd., in carrying out the many tests and calculations involved in the research; and of Mr. Michael Powell and Miss Saunders, of British Lion Studios, and the Still Department of that studio, for their active assistance in the preparation of these papers.

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DISCUSSION

Mr. F. V. HAUSER: The diagram of the five-wire system is quite clear, but the wiring is rather intricate on the floor. I had the pleasure of attending Mr. Hillver's demonstration at Shepperton, and agreed that it was quite feasible and worked admirably. A point that should be mentioned to-night is the part played by the Morgan Crucible Co. in providing suitable carbons for series running.

Turning to Mr. Hallett's figures, I feel he has made a conservative and reasonable study of the savings that can be effected. I foresee that for

big scenes it will become normal to work on the series system. In regard to Mr. Cardiff's paper, Mole Richardson have made big advances since that fine picture "The Red Shoes" was made, and Mr. Cardiff would have been helped if these advances had been available then.

I regard the development of this system as an important development in the British film industry.

Mr. BRIAN LANGLEY: Does any studio have these special carbons, and can any studio wire up the lamps in this manner?



Fig. 8. A Scene from the Ballet Sequence in "The Red Shoes."

Courtesy of J. Arthur Rank Organisation Ltd.

Mr. HILLYER: I know of no studio in this country that could not use the system.

Mr. DESMOND DICKENSON: Am I right in believing that this new lamp is ten times as powerful as the normal 170? Does it fit in the same lamphouse as "The Brute"?

Mr. HEYS HALLETT: The X6 lamp was shown as 1,040 units, as against 100 for the 170. Its performance figures are based only upon experimental data.

Dr. F. S. HAWKINS: The usual reason for running a three-wire system is to save copper in the bus-bars. You still need 115v. on two wires for the incandescents.

Mr. HEYS HALLETT: Thanks to the 40 per cent. economy in current, the existing copper is heavy enough.

Mr. DEREK STEWART: It seems that the maximum improvement outlined to-night is something of the order of 100 to 73. Surely the use of faster emulsions or lenses of wider aperture would represent a greater advance?

Mr. CARDIFF: When we have a large number of lamps around the set we have to break for trimming, and for twenty minutes it is just chaos. If we had fewer lamps, it would make trimming simpler.

Mr. F. G. GUNN: We (Technicolor) look forward to a considerable advance in the speed of our materials some time next year. It might reduce the lighting level to one-third. The figure shown in one of your tables of 5.6d. per kwh. seems very high.

Mr. HILLYER: The figure is arrived at by averaging the rates charged by various studios. Owing to the uneconomic operation of studio

power houses, due to brief heavy loads, any power house that makes a profit at that rate is doing well.

Mr. BAYNHAM HONRI: The new lamp should be of great value for exterior booster lights.

Mr. GORDON DYNES: So far we have not got stands suitable for raising these lamps high enough to make them suitable for outdoor booster lights. I would like a stand designed which would raise the new lamp 6ft. or more.

Mr. F. G. GUNN: Recently in the States they have converted a goods stacker which can raise a ton some 14ft. to 18ft., and can be driven over any sort of country.

Mr. T. H. BRIDGEWATER: We at Alexandra Palace have up to 350 kw., but now we have the Image Orthicon we are tending to go downwards rather than upwards. But new problems might rear themselves if we change to colour.

Mr. SAMSON: What is the difference in the new carbons?

Mr. HALLETT: The normal 150-amp. arc works at an arc voltage of about 64. It was necessary to produce a carbon working at a lower voltage.

Mr. MOSS: The carbon is definitely much steadier than the standard studio carbon, and the light is very similar to that of a standard 150-amp. carbon.

A VISITOR: Would it be possible to burn compact source lamps in series?

Mr. HALLETT: I do not think it will ever be possible to burn compact source lamps in series—the voltage is too high.

Mr. H. K. BOURNE: The voltage of the compact source lamp, as at present designed, is 70, and that is too high to enable two to be run on 115v.

BACK PROJECTION IN THE KINEMA

J. L. Stableford (Member)*

Read to the B.K.S. Theatre Division on December 12, 1950

BACK projection was probably introduced into early theatres because of structural difficulties. For example, old type music halls, where it was not feasible to build a projection booth in the conventional position, were converted to back projection. The screens in such cases usually consisted of cotton.

I. PRESENT SYSTEMS OF BACK PROJECTION

A cotton sheet will produce a substantial real image by back projection, but direct rays of light will pass through the weave and completely mar the viewing. Therefore, the cotton was treated with a type of varnish or linseed oil medium, and was even kept continuously wet by dripping water down it.

Judged by modern standards, the picture was unsatisfactory, even when the screen was new. The doping medium rapidly oxidised and collected surface dirt. The actual fibre of the fabric itself having a high refractive index therefore had considerable opacity. Whilst acting as an efficient diffuser, it also acted as an even more efficient absorber or stopping agent. Another unfortunate characteristic of this type of screen is that it acts as an efficient front projection screen; the doping of the fabric somewhat reduces this effect, but the net reflectivity is still substantial, probably of the order of 50%.

If a rear projection screen reflects back towards the incident ray something like half the total available light flux, there is only one-half of this light flux available for useful work. Of this remaining half, about 25% is absorbed by the textile material of the screen. The light that is available to form an image on the front surface of the screen is much attenuated.

A number of theatres have survived in this country to the present day with back

projection—somewhere between 30 and 40 out of a total of nearly 5,000—but I do not recall any theatre which has been designed and built for use with back projection. Certainly, it has been used on modern ocean-going liners, but only because of their special requirements.

Advantages of Back Projection

There are advantages of changing to back projection. For example, the severity of present day Home Office regulations produces an irksome technical and financial burden on theatre operators. If efficient and acceptable back projection were available, it is conceivable that the severity of these regulations could be relaxed.

In a normal assembly hall used for varied types of entertainment, the moment a film is introduced into the building these regulations come into force. If the picture could be projected from a source remote from the hall, there is no obvious reason why these regulations should apply. With back projection, a theatre could be designed so that the projection booth, film storage and all ancillaries of a hazardous nature could be housed in a separate building to which the public had no access. It would be joined to the main building by a fireproof trunking and fireproof shutters to the portholes. Consideration of this advantage, however, has not been sufficient to induce even an occasional change-over to back projection.

II. PHYSIOLOGICAL REQUIREMENTS OF KINEMA PROJECTION

Our greatest sensation of stimuli is received by foveal or central vision, where the acuity is of a very high order.¹ This foveal vision functions over an extremely narrow arc, approximately 1°, and the fact that we appear to see things with great sharpness over a substantial area is due to the fact that

* Stableford Screens Ltd.

the foveal vision is scanning at very high speed the dominating centre of interest. The remaining visual impression is gathered by macular or peripheral vision, which is not sensitive at high brightness levels. However, it has about 16 times the sensitivity of foveal vision at low brightness levels, to enable us to deal with low levels of illumination.

Objective consideration will suggest that only rarely does acute vision stray to the edge of the screen.

Matt and Beaded Screens

By far the most generally used screen for front projection today is the matt white. This gives a first-class picture over a very wide angle, and is expected to give a reflection factor of about 0.7. It is rather lacking response in blue and this is accelerated as, with increasing age, it yellows and finally browns, due to the deposition of tobacco tar. This tar exists in astonishingly high concentration in our kinema theatres.²

The glass-beaded screen, the second in general use, also suffers from the latter defect, but its virtue is that it gives a much brighter picture over a narrow angle, refracting and reflecting the ray in the direction of the light source. Thus, it should be used only under appropriate conditions. At the peak of its reflectivity curve, it can give a factor of 2.0 or 3.0, taking 1.0 as the reflecting factor of a 100% perfect diffuser and reflector. This high response has fallen to 1.0 at about $12\frac{1}{2}^\circ$ or 15° from the normal to the screen, that is a solid angle of 25° to 30° . The curve is not square-topped but has a sharp apex and falls steeply from the nodal point; it continues, but rather less, steeply, beyond the above angles.

Centre-to-Side Ratio

A matt white front projection screen gives a centre-to-side brightness ratio of about 1.5 : 1 with an average projection system, and it must be admitted that a centre-to-side brightness ratio of 2 : 1 is not so rare nor so objectionable as it would appear. It is true that projection engineers as a rule strive, at great trouble and expense, to

produce an illumination over a screen as even as possible, but there are many who consider that a completely even illumination over the whole of the screen is not desirable.

In my experience, a completely even illumination, even when it is of high brightness, produces a flat and uninteresting picture, and side-by-side tests, with two projectors of the latest type, have shown that a picture with 1.5 : 1 or higher centre-to-centre brightness ratio has more sparkle and life than one with 1 : 1 ratio. Indeed, this is very much in accord with our normal sensation of seeing.

Shortcomings of Kinema Projection

There are several fundamentals in which motion picture presentation falls short of nature, i.e.,

- Completely natural colour;
- Adequate contrast ratio; and
- Method of masking the picture.

Stereoscopy is omitted for the reason that it is outside the orbit of this paper.

Completely Natural Colour

If in the studio colours are painted in with all the delicacy of nature it is to be feared that a high proportion of them will be reproduced in the kinema only as monotone grey. There are two reasons for this.

Frequently the picture is inadequately lit⁴, consequently there is insufficient contrast ratio to generate colour in the lowest lights. The spectral response of even a new front projection screen is lacking in blue; as a screen gets dirty, there is a pronounced shift further to the red; it is equivalent to projecting colour through a pale yellow filter, then a dark yellow filter and finally a brown filter.

Contrast Ratio

Front projection screens as used today have been stabilised as to their contrast ratio. Their very efficiency as a reflecting agent limits their capacity for contrast. A picture is produced only by relative brightness; highlights must be produced at such intensity that the screen already illuminated by the house lights appears in the low-lights relatively black.⁵ An efficient back projection screen is a very inefficient front projection screen.

so that high orders of maintained house illumination have, consequently, a very reduced capacity to debase or degrade the low lights of the projected picture. This principle is being used in an ever increasing fashion in domestic television, by using a dark filter placed in front of the cathode-ray tube, so reducing the front reflection effect.

Change in Method of Masking the Picture

Viewing a motion picture through the encircling frame of a dense black mask is not the manner in which we normally view anything seen in nature. It must produce some jarring effect on the retina, particularly as the motion and changing light value at the edge of the screen, so abruptly cut off, are in the main viewed by peripheral vision, which is extraordinarily sensitive to movement and low key illumination. It is obvious that a good deal of unconscious accommodation has to be done by the eye to cope with these conflicting factors. The black mask is a relic of the days when we had insufficient illumination to produce a first-class picture, and subterfuges like this were almost compulsory.

If the black mask were suppressed and the picture gradually merged into the auditorium, less eye strain would result.⁷

This proposal is introduced into this paper because, if the suppression of the hard masking is carried out under conditions of back projection, it is thought that colours will appear more water-clear and natural, and particularly the blacks much blacker. The eye will lack the hammering effect of the black border, which does not help quiescent adjustment to the picture it is viewing. It might also be said that the picture will have a spatial effect, rather than that of a peep-show.

III. BACK PROJECTION IN THE STUDIO

Back projection has been in use for many years in the film studios, although up to about three years ago it had reached a static stage in so far as the screens were concerned. The main developments continuing along the

lines of obtaining ever more illumination. Even in the film studios, however, back projection was looked upon with suspicion. It was used for passing window shots in train or taxi-cab scenes, and limited to a very small area of the picture. One half of one per cent. of the whole film footage would probably represent the average use of back projection up to 1945.

The screens used in the studios were usually made of cellulose acetate and, although a certain amount of experimental work had been done on them, the characteristics were accepted as fairly standardised.⁸ Their overwhelming defect was the hot-spot effect. Some modification of this defect was produced by coating the centre of the screen with an absorbent agent, in order to deaden some of the brightness in that region. This expedient only partially met the trouble, as the extra opacity was effective only from one viewing point. As the studios were concerned only with one viewing point—the lens of the camera—this defect was not of much consequence.

Contribution of "Independent Frame" System

During 1946, a new conception of film production was envisaged, known as "Independent Frame."⁹ One essential requirement of this process was that 80% or even 90% of the film footage was shot with process back projection, and it will be obvious that the very gravest optical problems had to be faced in embarking upon such an undertaking. A very large amount of time, energy and money was spent by various producers and technicians in the solving of these problems. Yet, looking back in the light of the experience gathered in the years since the commencement of that process, an immediate answer to most of the problems was possible if a screen of specific characteristics had been available.

The essential characteristics of the desirable screen were that it should have no hot-spot from any viewing angle, when viewed with the picture in the gate, and only traces of a hot-spot when viewed with clear projection illumination. It had to provide

a sufficiently even picture over a wide angle so that the camera could pan, zoom or track, and the actors move about in front of the back projection screen without the effect showing in the resultant film. In fact, its characteristics should provide almost the same amount of scope and freedom as given by an orthodox set.

Characteristics of Translucent Screens

Measurements of screen characteristics, which were taken in the experimental work on screens used as a datum a theoretically perfect lambert surface with a factor of 1.0.

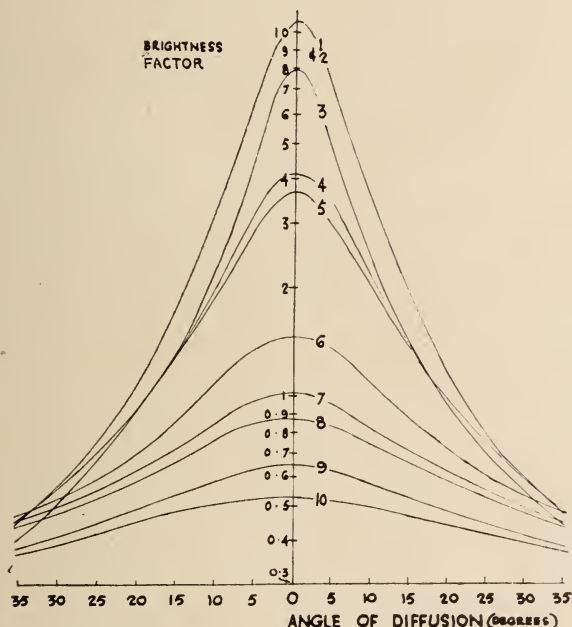


Fig. 1. Characteristic Curves of various Types of Translucent Screens, obtained by the use of different Grades and Quantities of Powdered Glass.

Courtesy of J. Arthur Rank Productions Ltd.

The lambert surface readings were taken at the same time as the other curves.

Fig. 1 shows such curves, taken by Hugh McGregor Ross.¹⁰ It will be seen that the range varies from a centre brightness 15 times that of the theoretical lambert surface, to a 1.5 : 1 ratio. The latter, however, is very dense and produces an unnecessarily high loss in overall illumination. For normal work, a centre-to-side brightness ratio of between 2 and 3 : 1 was completely acceptable, and this gives a brightness, as compared with a theoretically perfect lambert surface, of 3 or 4 times.

These are very high orders of efficiency and are probably beyond the scope of any generally used front projection screen material. It must be observed that the best of these screens were capable of producing a standard of quality beyond that required for entertainment purposes, since they had to be photographed by a camera, the film processed, positives made and then re-projected in a theatre; all this tending to degrade the definition and quality.

Kinema Tests of New Screens

As a practical experiment, four kinema

theatres, which were using back projection, and all of which had for long dissatisfied projection engineers, were selected. No particular screen characteristic was aimed at; what was thought would be a satisfactory screen was tried. It must be said immediately that the resultant picture, from the first showing, produced an astounding effect. On a picture 18 feet wide, the quality and brightness were better than anything seen in the West End or elsewhere. There was no sensation of hot-spot, and the coverage from the widest front stall seats was quite adequate.

An interesting characteristic was the spectral response of the screen. The picture shown on this occasion was "The Red Shoes"—a film which was a distinct step forward in the handling of colour as an art. In this film, several of the scenes are shot with the chief actors wearing evening dress, and, as is usual, their shirts were pale blue in colour. On normal front projection screens, either matt or beaded, which have a minus-blue reflectivity, these are reflected as a clear white. On the back projection screen, they were reproduced quite distinctly as pale blue, although it is doubtful if the ordinary patrons noticed this particular characteristic.

IV. PRACTICAL FACTORS IN USING BACK PROJECTION

Some of the more practical factors in using back projection will now be dealt with.

During a busy evening, a kinema theatre loses a high proportion of its picture illumination through scattering of the rays, both incident and reflected, in the dense tobacco haze. In foggy weather, this effect is increased, and under bad conditions the loss of light arriving in the retina of the patron can be as high as 40%. More than half of this loss can be saved by back projection—that is, the whole of loss in the incident ray and, shall we say, half that in the reflected ray. This is no mean attraction.

Again, it must be confessed that light scattered from the incident ray is most irritating to a patron sitting beneath it. Without any apparent loss of picture quality, it would be possible to increase greatly the maintained house lighting.

The location of the projection suite brings in a number of important factors, the most important of which is the length of throw. If we take a 2 in. lens as a datum, a 20 ft. picture needs a 48 ft. throw. This is an inconvenient length to find and cloak with a tunnel.

Projection by Mirror

The most obvious answer to this is to fold the ray once by means of mirror, the pro-

jection booth being placed immediately under the stage, where it could be housed conveniently as a suite. The ray would be projected from a point as near to the bottom picture line as is feasible, upon a mirror placed approximately half-way along the throw. This would necessitate a 10 ft. plate-glass mirror. The use of a mirror would not produce any noticeable loss of definition. The weak "ghost" image from the front surface of the mirror, if the latter were of $\frac{1}{4}$ in. plate glass, would be so near the main image, that probably it would be separated by less than the grain size of the film stock, as magnified on the screen.

The mirror would cause a loss of light of between 9% and 12%, according to its state of cleanliness, but this would be more than offset by the increased *T* value of the longer focal lens, which the double throw permitted. There is an additional advantage in using a mirror, that the projector could be laced up with the film the normal way round and not laced back to front or, as has been the usual practice, the picture reversed through a prism.

Life of Screens

The type of back projection screens we are discussing seem to have a life of three years or more, depending very largely upon missiles projected by young patrons.

It is an unfortunate fact that they are very expensive screens to produce, so that, amortised over a period of three years, the standing charges are somewhat higher than those for front projection, although it is thought that part of the expense might be saved by alleviation of resurfacing costs.

Insufficient experience has been gained in the use of such screens in the kinema to know the maintenance problems, although it can be said that in the film studios, they are washed regularly with soap and water. The inevitable deposition of tar will not have such a disastrous effect upon them as it has upon a matt white screen or a beaded screen.

A matt white screen is a reflecting agent by reason of the white particles of its make-up (omitting the more technical cause and

effect). If these particles are impregnated with a brown staining agent, such as tobacco tar, their very capacity to reflect has been destroyed to the extent of the colour to which they have been stained. If a translucent type of screen is stained to the same degree, its inherent capacity for transmission of light has not been destroyed at all. All that has happened is that a transparent filter, from the deposition of tobacco tar, forms on its surface.

Effect of Increased Brightness

If by increased brightness, visual acuity is stimulated, then the magnification factor can be reduced. This is aptly illustrated when one views an object under a reading lamp for closer examination; the acuity increases and as the viewing distance or magnification is left unchanged, the sight stimulus is increased.

The inference is that the increased brightness and increased acuity which the back projection screen can provide could lead to a substantial reduction in picture size without loss of visual sensation.

A smaller picture will improve the viewing conditions and sight line problems in almost all theatres, although it is not suggested that any wholesale reduction in size be contemplated. As an illustration of what must be the extreme in this, a special high reflection type of screen using a 20 ft. picture was being tested. When showing a richly

coloured scene under starlight conditions, a group of experienced theatre controllers and technicians were able to see an acceptable picture at 1,800 feet viewing distance. This is the unbelievable ratio of 90:1.

Sound Reproduction

There is one final aspect of back projection that must be mentioned, but on which no opinion will be passed, and that is sound reproduction. Obviously one cannot have a perforated back projection screen, and sound must therefore be disseminated from outside the screen periphery. The standard practice nowadays is to put the high frequency speakers above the centre of the screen and the low frequency speakers on either side, all three radiating through the wool masking. Theatre engineers who service such theatres have reported that they receive no complaints on sound and that, in their opinion, this arrangement is a workable one.

The advantages of back-projection were the subject of a number of demonstrations. Two identical 16mm. projectors ran matched prints side by side, one with front and the other back projection, the latter showing a marked superiority in brightness and contrast ratio. On a 2ft. screen, a picture was shown to be of adequate entertainment value at a distance of 30ft.—a ratio of 15:1. Another demonstration showed that the use of a mirror in the beam caused no perceptible loss of definition. The small effect of ambient lighting was also shown.

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DISCUSSION

Mr. R. PULMAN: I believe there are considerable mechanical difficulties to be overcome in sound head construction for rear projection. The question of speaker placement is very important; in view of the possibility of stereophonic sound, maybe the last place we want the sound is in the centre of the picture.

THE AUTHOR: I think a mirror is essential, when the film can be laced up the normal way.

Mr. WILLIS-CULPITT: Rear projection screens at the moment have sometimes a centre-to-side ratio of 4 or 5 to 1.

THE AUTHOR: The curve relating to the new screen is appreciably flatter. In the studio, we

worked at an angle of 60°, and did not get more than a 2 to 1 brightness ratio. At this angle a beaded screen would show about 5 to 1.

Mr. W. BLAY: Do I understand that the travelling hot-spot has been eliminated with this type of screen?

THE AUTHOR: With an open gate you can just see the increased brightness in the centre. But when there is a picture in the gate, nobody would see any change in the light.

Mr. A. S. HARKNESS: Could we have further elaboration on the maintenance of rear projection screens? This seems to be the main source of trouble with back-projection.

THE AUTHOR: The old rear projection screen had a cotton base, doped with some secret formula. Almost inevitably these screens oxidised, and collected surface dirt, and the problem of cleaning was quite out of the question. When reasonably dry dopes were introduced the problem of cleaning could be approached, but oxidation—the inevitable fall-off opacity effect—went on. The new screen has no cotton base, and the formula of the plastic can be designed to be as nearly as possible light-fast. The life from the point of view of the maintenance of picture brightness is a very good one. The deposit of surface dirt is the same, but it is an astonishing fact that the tar deposit does not deteriorate the light value of the screen to any marked degree. The life of the screen appears to be limited by the activities of the small boy.

Mr. HARKNESS: Do you agree that it is impossible to clean any type of screen in the theatre?

THE AUTHOR: I agree that it is very difficult.

Mr. R. PULMAN: Our experience is that after two years, the deterioration of the screen is much less than we should get with the ordinary front projection screen in six months. One of our control people—who is no technician—was so im-

pressed that when he was transferred to another area I received a note asking me to transfer all his theatres from front to rear projection.

Mr. HARKNESS: The reason a front projection screen turns yellow quicker than a front projection screen is that it is perforated.

A VISITOR: What would be the effect on reproduction by the screen in daylight?

THE AUTHOR: Under daylight conditions you would not hope to get a picture with a matt screen; you would get a slight picture with a beaded or silver screen. But with a back-projection screen you would get a picture provided it is hooded to keep light rays off the front of the screen, and that no stray light struck the rear of the screen. The front-projection efficiency of a back-projection screen is of the order of .25, as compared with .7 with a matt screen. With the beaded screen the efficiency of 3 to 1 would kill the possibility of daylight projection.

Mr. R. H. CRICKS: From the point of showmanship there are two factors in back-projection. One is that the beam is invisible, the second that the picture is covered by the tabs as they close.

THE AUTHOR: Prior to 1945, all studio screens were of American make. They had a centre-to-side brightness ratio of from 12 to 20 to 1. Efforts were made by Hollywood to produce screens for the Independent Frame process, but they never got away from the hot-spot.

Mr. HARKNESS: Do you consider that putting glass beads on the surface of the translucent screen would help? The Translux people do it.

THE AUTHOR: It has some effect on the characteristics, but it is so much bound up with the problems of size of bead, how they are bonded, the depth to which they are embedded, what other diffusing methods are used.

BOOK REVIEW

PROGRESS IN PHOTOGRAPHY, 1940-1950.

Editor-in-chief Dr. D. A. Spencer, editorial board W. F. Berg (London), L. E. Varden (New York), Prof. J. Eggert (Zürich) and T. A. Vassy (Paris). 463 pp. Focal Press, £2 2s.

The object of this volume is to record the many international advances throughout the whole field of photography during a decade, each subject dealt with by a specialist. Even in such a massive volume it is obvious that any reader will find his own subject inadequately dealt with, and in point of fact, only three chapters specifically relate to cinematography, dealing respectively with safety base, sound recording and high-speed and stroboscopic cinematography—and the first two of these, because of their brevity, will be of little value to the technician.

Nevertheless, because cinematography is a branch of photography, practically every chapter contains information of value in the motion picture field. S. O. Rawling, of Ilford, contributes a survey of the present state of sensitometry. P. C.

Burton, of Kodak, contributes three valuable chapters on the latent image and resolving power. A number of sections cover the field of colour admirably; two particularly useful chapters discuss accuracy of reproduction, and methods of correction by means of masking.

The remaining sections of the book are equally applicable to the motion picture camera as to the still camera: the recording of invisible radiations, applications of photography in law, in research, in business and industry, and in education. In another chapter are listed British, American, French and German standards in photography and cinematography.

The brevity of treatment of many subjects is compensated for by the lengthy bibliographies and lists of references which are appended to every chapter, and which in themselves provide an invaluable index to technical literature.

It is proposed to produce biennial editions of this work, which will thus form a permanent reference to photographic progress.

R. H. CRICKS.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

THE DUOMETER

L. Busch and E. Herrmann, *Foto-Kino-Technik*, July, 1950, p. 219.

A simple pendulum sensitometer is described for impressing two exposure patches on motion picture film. The two densities that result from processing are measured in a differential photometer to give a direct value for contrast, etc.

G. I. P. L.

COMBUSTION OF NITRO-CELLULOSE FILMS

L. Amy, *Bull. de l'Assoc. Franç. des Ing. et Tech. du Cinéma*, 1950, No. 7.

A survey of the chemistry of film combustion, and of its dangers, is followed by suggestions for prevention of fires. The principal cause is stated to be neglect of safety regulations.

R. H. C.

EFFECTS OF INCORRECT COLOUR TEMPERATURES ON MOTION PICTURE PRODUCTION

F. F. Crandell, K. Freund and L. Moen, *J. Soc. Mot. Pic. & Tel. Eng.*, 55, No. 1, July, 1950, p. 67.

The term "colour temperature" may be misleading when used to describe the colour balance of the illumination of a studio set. An instrument is described for determining the colour balance, and the factors controlling it and methods of expressing it numerically are discussed.

F. S. H.

THE STROBOSCOPE AS A LIGHT SOURCE FOR MOTION PICTURES

R. S. Carlson and H. E. Edgerton, *J. Soc. Mot. Pic. & Tel. Eng.*, 55, No. 1, July, 1950, p. 88.

Xenon filled flash tubes emit 24 flashes/second for long periods at loadings up to 4 KW. When used for taking motion pictures they have the advantage of efficient production and utilisation of light and colour rendering similar to daylight. Their disadvantages are flicker, which is objectionable to actors, sharp images in each frame of rapidly moving objects, and noise. They may be useful for some special effects.

F. S. H.

SIMPLE DEVICE FOR ULTRA-HIGH-SPEED PHOTOGRAPHY

H. Bartels and B. Eiselt, *Optik*, Jan., 1950, p. 56, abstracted in *Sci. et Ind. Phot.*, May, 1950, p. 193.

The image is focused upon a small mirror rotating at high speed, and thence upon a series of stationary mirrors, from which it is focused upon stationary film. Exposures as short as $1\mu\text{s}$. at intervals of $4\mu\text{s}$. have been achieved.

R. H. C.

INFRA-RED PHOTOGRAPHIC EVALUATOR

S. Horsley, *Amer. Cine.*, June, 1950, p. 196.

In order to evaluate the rendering of materials under infra-red illumination used to simulate night shots, an image converter tube is built into a portable unit, with viewing system and infra-red lamps.

R. H. C.

STUDY OF SEALED BEAM LAMPS FOR MOTION PICTURE SET LIGHTING

W. Blackburn, *J. Soc. Mot. Pic. & Tel. Eng.*, 55, No. 1, July, 1950, p. 101.

Sealed beam lamps, which are tungsten filament lamps of the photoflood type with part of the lamp arranged to act as a reflector, are light-weight and efficient sources of light. They cast shadows which are not as sharp as those given by the regular equipment, and are not so amenable to masking by barn-doors, etc., but it is shown that they can be used successfully both on location and stage sets with good photographic quality and a saving in production time.

F. S. H.

PROCESSES FOR MECHANICAL COLOURING OF FILMS

J. Marette, *Bull. de l'Assoc. Franç. des Ing. et Tech. du Cinéma*, 1950, No. 7.

A description of the PathécOLOR process, in which films were coloured through stencils, the latter being produced by means of a pantograph system.

R. H. C.

"AQUAFLEX" SUBMARINE CAMERA

Bull. de l'Assoc. Franç. des Ing. et Tech. du Cinéma, 1950, No. 7.

The "Aquaflex" submarine camera comprises a Caméflex camera built into a housing with horizontal and vertical stabilising fins. Lenses can be changed and focus adjusted from external knobs; instrument dials are illuminated. Drive is from a 6-volt accumulator. The housing is kept watertight by means of compressed air.

R. H. C.

"TRIARC" ARC LAMP

G. Lechesne, *Tech. Ciné.*, June, 1950, p. 149.

A projection arc operated on three-phase supply is provided with three co-planar carbons. At a current of 40 amps. the voltage drop between carbons is only 16v.

R. H. C.

NEW BRENKERT PROJECTION SYSTEM FOR DRIVE-IN THEATRES

C. N. Batsel and H. J. Benham, *J. Soc. Mot. Pic. & Telev. Eng.*, April, 1950, p. 483.

The need in drive-in theatres for a projection system capable of an intensity of 6 foot-candles in the centre of a 60 ft. screen has led to the development of an arc, burning at 170 amps., and fitted with an $f/2$ condenser system. The projector has twin-disc rear shutter, and is fitted with air cooling.

R. H. C.

A SOLUTION TO STEREOSCOPIC PROJECTION WITHOUT VIEWING DEVICES

L. Dodin, *Bull. de l'Assoc. Franç. des Ing. et Tech. du Cinéma*, 1950, No. 7.

In place of a screen a concave spherical mirror is employed; at the conjugates for the respective rows of seats are placed small mirrors, which reflect the image from a screen below the spherical mirror. The film carries alternate right and left images, and these are separated by means of drum shutters surrounding the small mirrors, which expose right and left images alternately.

R. H. C.

PSEUDO-STEREOPHONIC REPRODUCTION

Audio Engng., Jan., 1950, p. 15, abstracted in *Sci. et Ind. Phot.*, June, 1950, p. 238.

A stereophonic illusion may be obtained from a single recording, by causing phase and amplitude to vary as a function of frequency, with separate amplification and speaker systems.

R. H. C.

AN EXPERIMENTAL ELECTRONIC BACKGROUND TV PROJECTION SYSTEM

Wayne R. Johnson, *J. Soc. Mot. Pic. & Tel. Eng.*, July, 1950, p. 60.

In the production of a travelling matte for television purposes, the foreground subject acts before a white screen in front of one camera, and an electronic switch arranges that at the instant when the scanning spot on the camera traverses the subject, an "electronic hole" is produced on the scanning of the background into which the foreground signal is fitted.

The two difficulties which the author claims to have overcome are, firstly, that no part of the foreground subject can be brighter than the datum white screen, for if this occurs, then the electronic switch opens and the background is seen through that part of the subject; and, secondly, due to camera noise there will always be an uncertainty from the point of operation of the electronic switch, which would produce a halo round the foreground subject. The author claims to have reduced this effect by delaying the two sides of the "electronic hole."

T. M. C. L.

RECEIVERS FOR DOT-SEQUENTIAL COLOR TELEVISION SYSTEM

RCA Review, June, 1950, p. 228.

The latest direct-view tri-colour cathode-ray tube, and the additional receiver circuits required for driving it, are described. A three-gun and a single-gun form of the tube have been developed experimentally. Both use a mosaic of colour dots registered with an apertured mask slightly displaced from the screen so that the appropriate primary colour can be selected according to the direction in which the electron stream arrives at the mask. The triple-gun tube requires an additional 19 valves to the standard black-and-white receiver. The single-gun tube, in which the direction of the electron beam is adjusted to produce the different colours by an additional axial magnetic field, requires only 10 extra valves. At the moment, the number of groups of colour dots is not sufficient to give the full theoretical resolution of the American 525-line system, but it is proposed to increase this number in later samples of the tubes.

L. C. J.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library

TV NEWSREEL PRODUCTION TECHNIQUE

Telenews Productions undertake the presentation of a daily ten-minute news-reel, by which events of the day, recorded on 35 mm. or 16 mm., are transmitted in the evening.—*Inter. Phot.*, Dec., 1950.

INDIAN CENSORSHIP RULES

The newly founded Censorship Board proposes certifying films either for unrestricted exhibition, or for exhibition to adults, if necessary after the deletion of specified portions. The certificate is required to be included in the film, at a length of 15 ft.—*Journal of the Bengal Motion Picture Association* Jan., 1951.

EXPERIMENTAL CENTRE OF KINEMATOGRAPHY

The place of the Experimental Centre of Kinematography in the Italian film industry is described. The Centre has trained many of the present-day technicians and players.—*Unitalia Film*, Dec., 1950.

FRENCH FILM LIBRARY

At Boulogne-sur-Seine are housed $1\frac{1}{2}$ million feet of historical films—the only French collection of films which escaped damage during the occupation. This collection should, it is proposed, form the nucleus of a library of old and new films.—*Cineopse*, Feb., 1951.

THE COUNCIL

Summary of meeting held on Wednesday, January 3, 1951, at 117 Piccadilly, W.1

Present : Mr. L. Knopp (*Vice-President*) in the Chair, and Messrs. H. S. Hind (*Treasurer*), D. Cantlay, N. Leever and S. A. Stevens.

In Attendance : Miss J. Poynton (*Secretary*)

Apologies for Absence.—Apologies for absence were received from Messrs. R. J. T. Brown, W. M. Harcourt, T. W. Howard, B. Honri, R. E. Pulman and I. D. Wratten.

The President.—Members were happy to learn that the President's illness was not so serious as was at first thought, and that he would be discharged from hospital in a comparatively short period.

COMMITTEE REPORTS

Social Committee.—In view of the President's illness the Dinner-Dance was postponed until April 4. It would take place at Grosvenor House Hotel, Park Lane, W.1, and Vice-Admiral the Earl Mountbatten of Burma would be the Guest of Honour.

Theatre Division.—The National Association of Theatrical and Kinema Employees had asked for permission to publish the brochures compiled by the Film Mutilation Brochure Committee. As the brochures needed revision and the whole question of film mutilation was being further considered, publication would be withheld for the present.

Questions turning on the qualification of projectionists within the Society were being considered.—*Report received and adopted.*

Education Committee.—A Course of Lectures on "Sensitometry" would commence on February 26 at Kay's (West End) Theatre, Movie-tone House, Soho Square, W.1, and Mr. I. B. M. Lomas would be the lecturer.

A further Course on "Lighting for Kinematography" would commence on February 26 at the Colonial Film Unit Theatre, 21, Soho Square, W.1. The syllabus would be the same as for the previous Course.

The question of the publication of the Lectures was being considered.—*Report received and adopted.*

Television-Kinema Group.—A Committee, representative of the British Kinematograph and the Television Societies, had met to consider the formation of the above Group. Twelve conclusions had been reached, as follows:—

1. The Group shall be called the KINEMATOGRAPH-TELEVISION Group; abbreviated to *K.T.V. Group*.
2. It shall have for its objects the promotion of the study and discussion of the joint application of television and kinematography for entertainment and educative purposes.
3. Membership of the Group shall be confined to one grade—Member—for the time being.

4. It is intended that the Group shall be limited to professional members in either industry.
5. The expenses of the organisation of the Group shall not be an additional load on either Society, apart from an initial grant towards its formation.
6. The operation of the Group shall be directed by a sub-committee of not more than 6 members, drawn from both Societies, and the office staff of the B.K.S. will be available for clerical work.
7. The Chairman of the Group shall be elected annually, and the office shall be held alternately by a member of the B.K.S. and the Television Society.
8. While members of either Society are free to attend meetings of the Group, registered membership of the Group shall only be made on payment of a fee, which will entitle the member to special privileges of voting and copies of the Proceedings.
9. An inaugural course of 4 lectures on "Television in the Kinema" will be arranged, for which a fee will be charged. These lectures will be given by experts from each Society.
10. The Group will be self-governing, and will prepare its own bye-laws and programme, subject only to the approval of the respective Councils.
11. Patron Membership of the Group shall be invited.
12. A maximum amount of £15 shall be donated by each Society towards the initial expenses of formation and lectures.

It was hoped that the Group would be formed in time for a lecture programme to be planned for next session.

B.S.I. Exhibition.—It was felt that the Society could not accept the invitation extended by the British Standards Institution to be responsible for an exhibit at the exhibition "Fifty Years of Industrial Standardisation." Every assistance would be given, however, in co-ordinating an exhibit.

"British Kinematography."—The Journal would be published in new format from January onwards.

The proceedings then terminated.

BRITISH KINEMATOGRAPHY

Your last year's copies of this Journal (Volumes 16 and 17) can be bound in blue cloth with gilt lettering, price
17s. 6d.

A limited number of bound volumes for 1949 (Volumes 14 and 15) are still in stock, and bound volumes for 1950 (Volumes 16 and 17) will be available, price
£2 12s. 6d.

BOOK REVIEW

Books reviewed may be seen in the Society's Library.

CINEMA ITALIEN D'AUJOURD'HUI, Alexandre Blasette and Jean Louis Rondi. Carlo Bestetti, Edizioni d'Arte, 77 Via della Croce, Roma, Italy. L2,000 (approx.).

For the first time a book has been published giving full details of the history and development of the Italian film industry. Sections are also devoted to the artistes, technicians and to the documentary film. In the appendices graphs show the growth of the Italian industry since the war; figures of exports and imports of films are also given.

One of the finest sets of still photographs I have seen illustrate many hundreds of films produced in that country. These, together with the informative text, will make this book a necessity for all interested in the Italian film.

A. R. R.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

J. P. J. CHAPMAN is completing an historical film for the Poole Corporation in 16 mm. colour.

FRANKLIN GOLLINGS is now convalescing in Scotland from an operation.

REX B. HARTLEY, chairman of the Foreign Relations Committee, is shortly paying a visit to Jean Vivié, secretary of the Association Française des Ingénieurs et Techniciens du Cinéma.

K. S. PIKE has joined the Shell Film Unit.

W. J. RAYMONT announces that the address of the Cinetra Manufacturing Co. is changed to 12 Oval Road, N.W.1

ALAN J. WILLIAMSON, B.K.S. Australasian representative, has resigned his position in the J. Arthur Rank distributing organisation, and is returning to this country for a brief period.

PERSONAL ANNOUNCEMENT

Mr. S. N. Agarwal, Managing Director of Cinefones (Delhi), Ltd., Partner of Cinefones, Bombay, and Director of Cine Supplies, Ltd., Bangalore, Madras and Secunderabad, will be visiting England and other Continental countries during April/May, 1951. Manufacturers and suppliers of 35 mm. Motion Picture Equipments are requested to contact him at his firm's address: Messrs. Cinefones, 3, New Queen's Road, Opp. Opera House, Bombay, 4. Quotations for Studio Equipments,

spare parts, accessories, like studio bulbs, Tungar bulbs, mirrors, etc., are gladly invited.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.

Specialist in 16mm. Film Production



Documentary • Medical • Industrial • Commercial

BRITISH KINEMATOGRAPHY

VOLUME 18, No. 3

MARCH, 1951

MEMBERSHIP APPLICATIONS

THE Membership Committee has frequently experienced difficulty in determining the acceptance of applications for membership of the Society because candidates have not supplied sufficient information. In some cases there has been a delay until the Committee has obtained the necessary supporting particulars and in others applicants have been placed in lower categories because their higher qualifications have not been disclosed.

To overcome these difficulties the Council has approved a new application form for membership which the Committee has proposed and it will be brought into use immediately the stock of old forms has been exhausted.

The new form will require more detailed particulars of the applicant's technical training, experience and qualifications and the candidate's proposer and seconder will both be required to confirm from personal knowledge the accuracy of the information.

In order to avoid delays or the relegation of a candidate to a lower category of membership, proposers and seconders are requested to familiarise themselves with the regulation concerning membership which will be printed on the form in order to ensure that the applicant complies with the requirements of the grade to which he seeks admission.

It is hardly necessary to point out that a responsibility rests upon proposers and seconders that their support should be given only to those candidates whom they consider comply with these requirements and whose membership will reflect credit upon the Society.

In some cases the Committee has found it difficult accurately to appraise the applicant's technical ability, and therefore the form requires the names and addresses of two persons to whom reference can be made in cases of doubt, or where fuller information is required.

Finally, it may be mentioned that the use of a special transfer form will be discontinued. The application form will be used also for cases of transfer by completing those parts of the form indicated.

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MODERN TRENDS IN ART DIRECTION

M. J. Morahan*

Read to a joint meeting of the British Kinematograph Society and the Association of Cinematograph & Allied Technicians on January 17, 1951

FOR the most part the public think of films in terms of personalities, situations and plot, rather than in the backgrounds. Commenting on this fact many years ago, John Betjeman speculated harshly on what he felt passed through the minds of the film magnate when he was planning a film. These, said Betjeman, are the things the producer considers to be the chief constituents of a film in order of commercial value:—Kisses and other displays of concupiscence; stars; story or type of film; speed of action: slow for simple audiences, fast and American for sophisticated West End houses; music; dialogue; dresses and scenery.

These sentiments were expressed many years ago, and in general no longer hold good, at least in England and on the Continent. Hollywood, however, still clings mainly to that conception and the star system is as strong as ever. There is no doubt that for many years film audiences became drugged to accept a certain type of mounting that was larger than life.

Continental Influence

Continental films first awoke to the need for good art direction, but they were not seen except by the discerning few; it was the steady progress of the documentary film, the actualities of war and the steadily improving taste of the public, which created a demand for realism in films.

Fortunately, the art departments of England were ready for it. During the years preceding the war, from the boom period starting with "Henry VIII," the Continental influence had reached our art departments; Alfred Junge, representing the German School, had come even earlier. Vincent Korda, Lazare Meerson and Erno Metzner had a school of draughtsmen and

assistants, a considerable number of whom are now Art Directors or Production Designers. We had a few Art Directors who were architectural in their approach, for example Laurence Williams and his school at the British and Dominions Studio, Ealing. With the expansion of the industry new blood came into the art departments—men with architectural training or artistic background who had an artistic conscience and knew that it cost no more to do the thing right than to do it wrongly.

Demands of Realism

The aim of the new school was to be realistic when realism was right, or to be imaginatively creative when it was not. Thus when the war came, we had the nucleus of men who knew how to cope with the demands of realism. After the war art direction became functional in that the setting had to be completely authentic, being integrated in a design which no longer attempted to be larger than life.

The public had at last realized that truth is stranger and even more entertaining than novelette fiction, and this trend has affected every department in the making of films. There are of course subjects more detached from life which require a different approach, and we have comparative newcomers to the film medium such as Roger Furse and Hein Heckroth. The two trends in art direction are therefore, architectural or realistic approach, and the dramatic or creative.

Colour in Films

The subject of the dramatic approach leads naturally to the question of colour in films. Here Production Design, which is the key to the dramatic approach, comes into play more than it does in black-and-white. Nature nearly always looks

* Ealing Studios, Ltd.

right in colour, and distance and atmosphere usually merge even wrongly coloured figures into the landscape, or at least soften the visual effect. But in the case of interiors it is not so; no amount of good lighting will overcome badly designed scenes in colour. In black-and-white the cameraman can separate tones with the use of light, but it is infinitely more difficult in colour.

Thus the Production Designer in colour

"Black Narcissus," "The Life and Death of Colonel Blimp," "Men of Two Worlds," "The Red Shoes," and "Saraband for Dead Lovers," to mention a few, and he has used colour to help the director and cameraman to create the mood of the scene.

The "Ten-Minute Take" Technique

Another manifestation of the dramatic approach was Alfred Hitchcock's so-called



Fig. 1. Design by Hein Heckroth for the "Red Shoes."

(Courtesy of the J. Arthur Rank Organisation, Ltd.)

films has become recognised as practically essential, and even if the designer does not actually design the clothes he very largely controls their colour, particularly in period subjects. Naturally, he is in constant consultation with the cameraman. In America, the dress designer as such is practically dispensed with, except perhaps for special gowns for the female star, the responsibility resting with the Production Designer.

In England the Production Designer has been predominant in all colour successes,

"ten-minute-take."¹ My brother, Tom Morahan, was Production Designer on the film "Under Capricorn." First he was handed a treatment and had a general discussion with the director; he then laid out a plan visualizing the action dramatically, sketching it out in preliminary thumb-nail sketches, and larger sketches for general character and main set-ups. Constant reference was made to the camera angles, with scale cut-outs of the available crane and dolly; at the same time he had to consider



Fig. 2. Set of Alfred Hitchcock's production "Under Capricorn."
(Courtesy of Transatlantic Pictures Corporation.)

the mechanical difficulties—how walls and stairs, etc., could "float" during a take so that the camera could traverse the whole house in one take, both upstairs and downstairs.

As the stage space was cramped, this was a particularly difficult problem, as not only had the exterior of the house to be included, but the garden and a suggestion of landscape as well. All had to be floatable and had to be on a perfect surface to take the crane and dolly without tracks.

Over and above the difficulty of obtaining a continuous plan of good set-ups, he had also to think of tempo. Theoretically, there was to be no cutting, therefore, he had to aid the director by making each part

of the set exactly the right size, besides being photographically correct, so that the characters would take the right number of paces from point to point according to the speed with which they would move in their various moods. After he had achieved his composite design the director studied the designs and made his famous little thumbnail sketches. It may be a compliment to the clarity of the writing of the treatment, or to the designer's power to get inside the scenes dramatically, that very little alteration was needed.

Location Interiors

The awakened sense of reality has induced producers to supplement their studio facili-

ties by shooting real interiors. However, when this style of production is attempted, and real interiors are mixed with studio settings, the art director and cameraman are presented with a new set of problems. Technicians who have worked on films in which certain of the interiors are shot in the actual location may recall the shock they experienced when seeing such scenes cut into a picture together with studio settings. The style of treatment, from both the cameraman's and the director's point of view, changed completely when they were in these real interiors, and the studio fake stood out conspicuously by comparison.

The Sense of Reality

Reality in motion pictures is obtained by the avoidance of a contrived plot, by so-called natural acting and dialogue, by authentic looking settings, and by the complete subservience of each technical department to the requirements of the picture as a whole. The spectator should be kept in blissful ignorance of the blood, sweat and tears of each individual technician. Cutting of music, photography, and settings should be inconspicuous, carefully tailored round the body of the film.

Ealing Studios have made much use of real interiors in many of their films, but of course in practice they can only be used in special circumstances. There are difficulties of sound and lighting to contend with, often additions are required such as beams to mask the spot-rail, baffles for improving sound, re-dressing and sometimes repainting, or even additional building. Nevertheless, short key scenes shot in this way are very useful, as for example in "The Blue Lamp." Here real and studio interiors were intermixed, and the art director's aim was to maintain his consistency of style during the unfolding of the story.

Matching Studio and Location Shots

When matching the studio interior with the real, the following should be borne in mind:

Architectural.—The style of the location interior or exterior should be adhered to. A

sufficient amount of reference stills of the actual location must be obtained, and several others of the same character to enable the sets required in the studio to be designed, the details based on authentic reference.

Finish and Texture.—This should be discussed with the cameraman. A high gloss finish or a matte finish may be preferred. Samples of colour schemes and even samples of wallpapers should be submitted for the cameraman's approval.

Ceilings and Floaters.—This side of set design and construction needs far more co-operation and discussion than ever with the director, the cameraman and the sound department. If the set-ups have been thoroughly planned, and especially if the visual system has been used, every float can be marked on the drawing, and if necessary, the design altered to suit a particular floater required before the drawings are issued to the construction department. Ceilings present two problems; they may be floating or adjustable, to suit the lighting, or made of muslin or some non-resonant material to comply with sound requirements.

Absence of excessive top or back lighting.—Complete co-operation with the cameraman is essential. He will try to imagine when he is in the studio that he is working under the same conditions as when he is photographing on location. There top lighting is restricted, and some directors contend that these restrictions tend to improve the subject, and as the lighting of the studio sets have to match, the resultant style is improved.

The Mobile Studio Unit

A mobile studio unit was used in the spring of 1950 for the film "The Magnet." The location was on Merseyside. As on a former occasion² a church hall was converted for the location studio, the experience gained on the first exploit proving most useful. This unit was also used for the film "The Pool of London," which had considerable locations in that area, and also a big proportion of night shooting. An

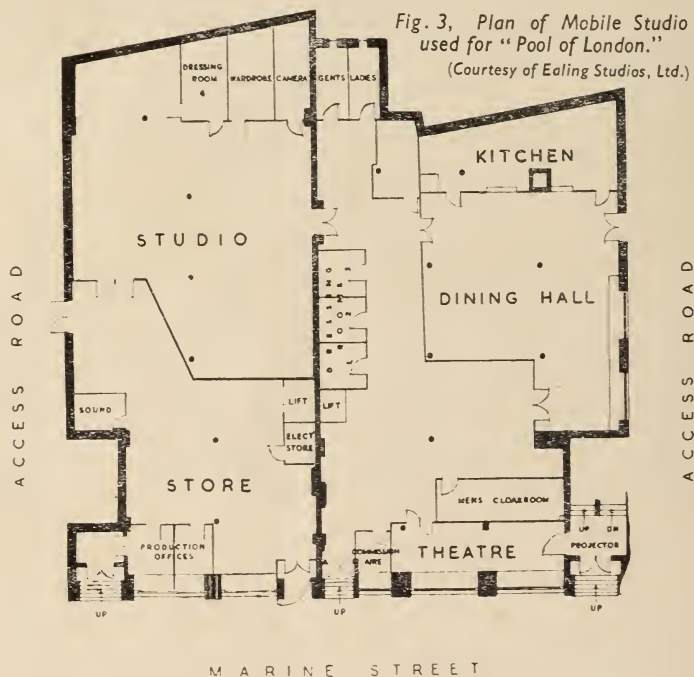
empty warehouse was rented at Bermondsey and converted into location headquarters with canteen, dressing rooms, projection theatre, offices and a small portion as a studio.³ As Art Director on these three productions, I should like to comment on some of the problems that affected the sets.

In the first place the premises had to be surveyed, then consideration given to the sound-proofing, ventilation, fire precautions and fitting up of temporary quarters for the various departments. Sets had to be designed to profit best from the limited

manager, were of great use. The "Pool of London" temporary studio was confined to small sets of offices and crew's quarters, the cameraman having the worst problems owing to the low ceiling, but even so the sets proved very useful as bad weather alternatives.

Models and Glass Shots

Foreground miniature,⁴ models and glass shots⁵ play an important part in film production. One of their objects is to save building large sets, for which reason they



studio space, taking into account the overall size of the premises, the height of roofs or beams, and the problem in two instances of avoiding stanchions; also prefabrication had to be so arranged that sets were in suitable sections for transportation, and that they would pass through the entrance to the temporary studio.

On the Merseyside location, a larger studio was used, and therefore larger sets were utilised. The improved equipment and methods, notably the portable and adjustable spot legs designed by the construction

are generally associated with productions in the high budget class, which call for large and elaborate settings.

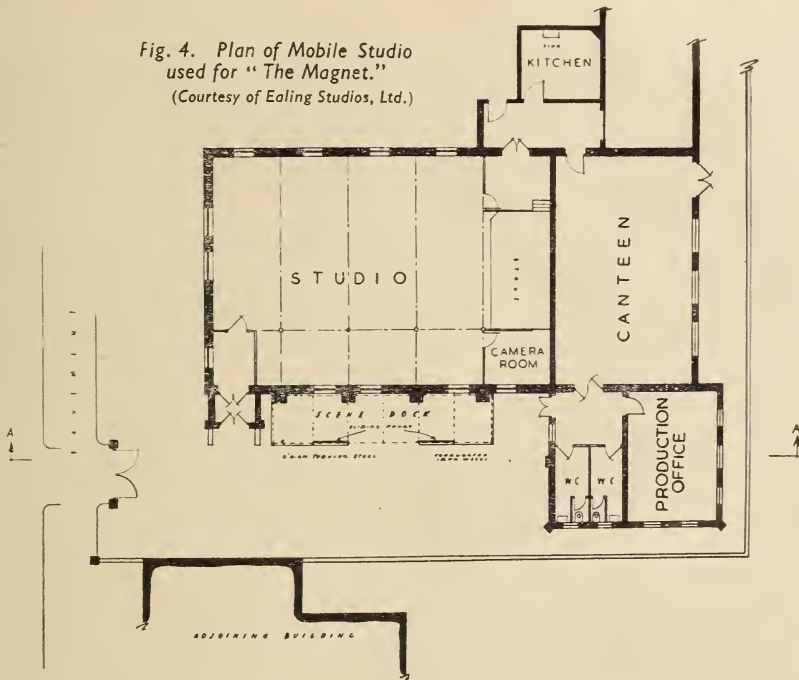
During the war models were much used at Ealing Studios, not because high budget pictures were being made, but because of the black-out, and because locations were very much restricted. There is a stage at Ealing still known as the Model Stage, but the last production to have a really spectacular model set on it was "Scott of the Antarctic."⁶ This was a tank set, with ice floes and model ships, models being the

only way of securing these shots. In the last two years models and foreground miniatures have figured only occasionally in our productions. This coincides with the fact that the cost of production has had to be brought down. Glass shots and painted cut-outs still find application, whether they are lined up and shot at the same time as the set, or are matted in after, the latter requiring the minimum of time and labour.

On the production now in hand, "The Man in the White Suit," it was intended to shoot plates for stereopticon or back pro-

In the new process the foreground action is shot in the same way as in the Dunning process, against a backing lit by blue light, the artistes and set being lit by yellow light. Two films are exposed in the camera, the yellow-lit foreground being recorded on a panchromatic film, and the blue-lit background on a blue-sensitive film; the latter produces a silhouette of the foreground image, and in the optical printer is used as a travelling matte. A feature of the process is the complete absence of fringing around the matte.

Fig. 4. Plan of Mobile Studio used for "The Magnet."
(Courtesy of Ealing Studios, Ltd.)



jection and to find locations for some of the exteriors in Lancashire, but owing to the time of year, it was found impossible to get good results. Foreground models and model backings have been utilised.

The Split-beam Process

The travelling-matte process—one version of which, utilising a beam-splitter camera, is the subject of a demonstration film made by the J. Arthur Rank Organisation⁸—enables backgrounds, interior or exterior, to be shot without artistes, as in process projection.

The place of the Art Department in this process is that all the shots have to be very accurately worked out. The Split Beam process has been used at Ealing on the last two productions, "The Lavender Hill Mob," in which some of the scenes took place on the Eiffel Tower, sections of the lift, the spiral staircase and the terrace and café being built in the studio and the background only shot in Paris; and on "The Pool of London," where this process was used for shots of a man suspended and then falling down the shaft of the Rotherhithe

Tunnel, also for shots of a jump from a high building on to the roof of another.

Set Costs

It is the Art Director who has to estimate the cost of his proposed sets, the amount of timber likely to be used, the plaster, paint, bessian, photo backings, scenic canvas, the construction wage bill, the modelling, moulding and casting of models and trick shots, the hire of props and set dressings and the making of special props. What stock can be used, stock flats, doors, windows, columns and enrichments and the

keeping set costs down is to have a script sufficiently finalized and the set-ups planned, so that only the minimum required is built. Overbuilding increases costs, not only because more material and labour have to be used than necessary, but because a set takes up more floor space and there is more to encumber operation on the floor, particularly when the set is built higher than is ultimately necessary. The Art Director has to use his discretion and experience—or it might even be described as intuition.

The rising cost of materials has, of course, sent up set costs quite considerably. An



Fig. 5. Soundproofing the Mobile Studio used for "The Magnet."

(Courtesy of Ealing Studios, Ltd.)

"revamping" of existing sets—all these are considered when estimating the cost of a set.

The really important consideration in

average that used to be worked on was one-fifth of the total for materials, but recently on some sets the cost of materials has almost reached the cost of labour.

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DISCUSSION

Mr. B. HONRI: The studio at Bermondsey was not a very ambitious building operation. The offices consisted of flats, put up in a few hours.

Mr. C. WHEELER: Who is responsible for erecting sets large parts of which are not shot on?

THE AUTHOR: The normal procedure is to discuss the set required with the director and cameraman and associate producer. We have a system at Ealing by which all three have to sign the drawings. But sometimes there is an alteration in the script which affects part of the set.

Mr. W. HAGGETT: I should like more information about how one chooses these mock studios.

THE AUTHOR: We do not choose the building for its exterior. The problem is mainly to find premises that are vacant and can be hired, that can be converted to provide a reasonable floor space and height, and be close to the location.

Mr. W. S. BLAND: I notice that in the Merseyside hall you use slag-wool insulation, which was, I take it, a considerable increase in cost over the Barra installation. Do you use anything further to block up the windows?

THE AUTHOR: No, we only used slag-wool over the windows at Barra. For the Merseyside location slag-wool was fixed in frames over the windows and walls. No other insulation was used over the windows. We always have the sound department at these discussions on the sets. We have paper models of every set so that we can see

all the problems. We always make a point of angling every set—of not making it a complete box.

These models are not built of wood or plaster; they are the blue-print drawings just cut out.

Mr. C. WHEELER: Models are invaluable in assisting those who cannot visualise things from drawings. But I go back now to some years before the war when, after pressure from the sound departments, sets were taken care of in respect of sound, not only acoustically, but in respect of extraneous noises—clicks and things of that nature. Staircases were felted between risers and treads. But when war came, materials became short, and one could not press for perfection.

THE AUTHOR: It is an automatic thing that stairs are always felted under the risers and treads. It is the incidental things that might go unnoticed. There might be a weak floor in part of the studio where the set is built. The new timber we get twists after the set is built and starts cracking.

Mr. HONRI: The points mentioned by Mr. Wheeler become increasingly important, because as improvements such as push-pull come along there is a tendency for directors to let actors "throw their lines away." That means that gain has to be raised, and clicks and rustles and clothes noises come up.

BOOK REVIEW

Books reviewed may be seen in the Society's Library.

THE HISTORY OF THE BRITISH FILM, 1914-1918, by Rachel Low. 332pp. + 24pp. of stills. George Allen & Unwin Ltd., 35s.

In one respect this, the third volume of Rachel Low's monumental work, is of greatest interest: to an increasing extent it deals with a period which is within the recollection of many of us—a period which is not simply history, but within our own knowledge.

Pioneers like Hepworth and Barker were still the leaders of the trade, but on every page one finds other names still well known. Films of the 1914/1918 war were being made under the direction of W. Jeapes and Paul Kimberley; among the cameramen in France were F. Bassil, Walter Buckstone (after the war cameraman to George Pearson) and Matthew Raymond; wartime cartoons were being made by Anson Dyer, and Adrian Brunel assisted in distribution.

Two of the leading producers of the day were Maurice Elvey and Thomas Bentley, while under the late Simon Rowson (first President of the B.K.S.) Ideal Films went into production. J. H. Martin at his studio at Merton gained a reputation for trick films. Hepworth's producer was Tom White and his cameraman was Geoffrey Faithfull, while Dave Aylott and Will Kellino were producing for Cricks & Martin.

It was within the period covered by this book

that the exclusive film ousted the open-market product. It was within this period that the American film assumed its for so long unchallenged supremacy; this fact is commonly attributed to the effects of the war upon our producers, a view with which Miss Low hardly concurs.

For those of us with personal acquaintance with the workers of those days, this volume is marred by a cynically critical outlook upon the standard of production—a lack of historical perspective. It is true that the artistic creative mentality which is responsible for the best of our films to-day had not yet been attracted to the industry; but it must be remembered that exhibitors and their audiences had only recently graduated from the fairground, and the class whom Miss Low describes as the "ton patron" was only with difficulty attracted to this comparatively new entertainment.

Baynham Honri contributes an all too short technical appendix. Two minor corrections to this: films were never processed at the Cricks & Martin studio in Croydon, but at a separate laboratory a short distance away; Bricfo film stock was made at Ashted, not Ashford.

The large number of stills which illustrate the book, many of them enlargements from film frames, testify to the high standard of photography which was by then being attained.

R. H. CRICKS.

THE FILM IN RESEARCH

R. McV. Weston, M.A., F.R.P.S. (Member)*

Read to the British Kinematograph Society on February 7, 1951

FROM the earliest days of scientific investigation, the research worker has pressed into his service all and any method or device which would enable him to make his measurements more accurately, make his observations more easily, or widen the scope of his physical senses. Equipment of this kind constitutes the tools of the research worker, and ranges from the simple pencil, ruler and paper, on the one hand, to the electron microscope, the 200-inch telescope, and the electronic calculating machine on the other.

During the last hundred years, photography has been used by all kinds of research workers because of its obvious advantages, such as speed and freedom from human error.

About 70 years ago, two independent workers, an Englishman and a Frenchman, interested in different branches of biological science involving movement, were at work on new photographic methods, and from these men—Muybridge and Marey—came the foundations of motion picture photography and the use of motion pictures in research.¹

The motion picture is before the public mainly in its entertainment form, but the fact must not be overlooked that it was first conceived and produced, not to entertain and amuse mankind, but to widen the horizons of human knowledge and to facilitate serious scientific research.

Value of the Film

Let it first be asked, why it is that the film is such a valuable aid to the research worker? The reasons are not difficult to find, though they are not always fully appreciated. They may be enumerated as follows:

1. A detailed, accurate and permanent record can be made of almost any event.

2. The recording can be made automatic in operation, thus dispensing with a human observer.
3. The method is applicable to almost any object that can be observed either with the unaided or the aided eye.
4. Most of the information in the record is readily available in visual form without interpretation or calculation.
5. There is no mechanical interference with the object under investigation.
6. Measurements of time, velocity and acceleration are easily obtained.
7. Alteration of camera speed alters the apparent speed of the event recorded.
8. Invisible radiations may be used, to which the eye is not sensitive.

Other recording methods, for example, oscillographs and kymographs, fulfil some of the above functions, but no method, other than the motion picture, combines them all.

It is not possible to say which of the above qualities is most useful to the research worker, as each problem will make different demands upon the motion-picture camera, but cases are frequently encountered in which no other recording method is suitable, or indeed possible.

The measurements of time or acceleration and alteration of apparent speed are perhaps the most important from the scientific standpoint, because in these two groups we are concerned with actual measurements and with the observation of events outside the narrow range of speeds that can be appreciated by the eye, rather than with the mere recording of events. The alteration of apparent speed gives information which is not available by any other means. No other technique or recording method gives the same command over time that is available from the motion picture film.

The above headings can now be considered in more detail, together with some actual examples.

* Simpl, Ltd.

1. Detailed, accurate and permanent Records

Simple film records of events contain a wealth of detailed information and at the same time eliminate the personal errors and discriminations of human observers, and provide a permanent record for close study at leisure. The author recently made some records of cells growing in tissue culture, and the film contained so much information that in order to analyse the speed of movement of only a sample of the cells in the field (without taking into account their directions of movement), a single worker was engaged whole time for more than a week.

Film records of such events as the explosion of an atomic bomb² are examples of this type of film. The film record is available for detailed examination when repetition of the event itself is impossible.

2. Automatic Operation

The motion picture camera can be used when it is not possible to employ human observers. It will withstand physical conditions which might be fatal to a human being and it can be accommodated in a very small space. Recent films of the surface of the earth taken from rockets, or the facial expression of aircraft pilots during power dives, are well-known examples of work of this nature.

3. Use with Optical Instruments

Work in this class includes the use of the motion picture camera in conjunction with the microscope, the telescope and certain other optical instruments, such as the interferometer.

Very little work has yet been done in conjunction with the telescope, though recent films of solar prominences made by Lyot and others are among the most wonderful research films that have ever been made. Work with the astronomical telescope is exceedingly difficult, and the economic factor alone certainly limits the amount of film produced per annum.

The interferometer has also been used particularly with the microscope, to investigate the action of solvents on plastics, but

this practically exhausts the list of optical instruments that have been used with the motion picture camera to date.

4. Simple Interpretation

Many recording instruments provide a record which requires interpretation before it can be used for study and is, in consequence, difficult to explain to a layman. Kymograph records are of this type, and also the very complex records of the electroencephalograph.

The majority of film records, on the other hand, are easily understood and appreciated by a non-technical person. This is of the greatest use in industrial research where, for example, high-speed films of machines have to be shown to business executives. Such films speak for themselves with ease and conviction.

5. No Mechanical Interference

The fact that the making of a film of an event does not interfere mechanically with the object under observation is often of very great value. As examples of this may be mentioned the recording of the gaits of small animals and insects,³ and the bursting of bubbles.

Circumstances do occur when it is difficult to avoid some interference with the object being investigated, for example thermal effects and the like, but it is unusual not to be able to find some way round difficulties of this kind.

In certain classes of biological work, however, the mere presence of light may have a very disturbing effect on the animal being studied, and cases of this kind are very difficult to handle. They are, fortunately, quite rare.

6. Measurement of Time and Acceleration

Provided the speed of the motion picture camera mechanism is known, the resulting film can be used for timing and measurement purposes. The measurements most frequently required are:—

- (a) duration of an event;
- (b) velocity of an object;
- (c) acceleration, either linear or angular.

Timing Methods

It is interesting to look back at the historical and original work of Marey, as he was probably the first person to embody accurate methods of timing in his photographic records. Accurate timing was, to Marey, one of the most important aspects of his work which he called "Chronophotography."

Method A. Time marker within the field of view of the camera. This is the oldest method and is illustrated and described in

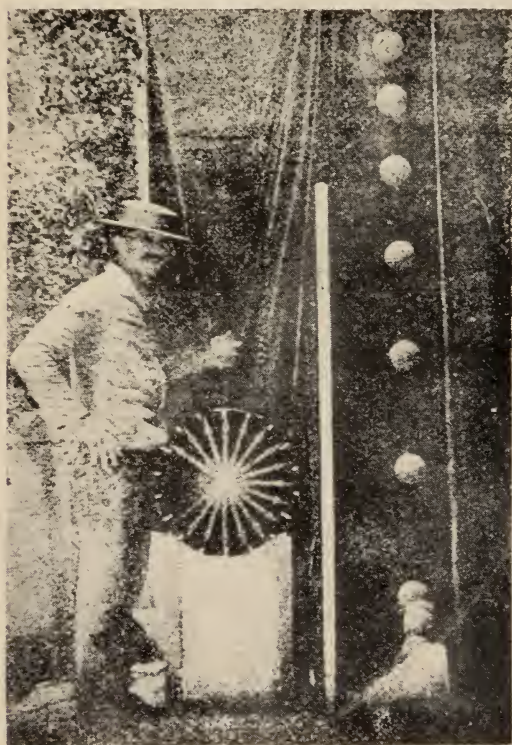


Fig. 1. Early Timing Apparatus of Marey showing the Acceleration of a Falling Body due to Gravity.

Marey's book "Movement" of 1895. He used a rotating pointer driven at a known rate by a carefully regulated clockwork mechanism, and the pointer was included in the field of view of the camera.

The method is simple and is still a useful one today in certain cases, and can be used either with a suitable clock or watch or a small synchronous motor,

Method B. Motion picture camera driven at a known rate. This method is also simple to arrange, but the accuracy is usually rather low, depending upon the type of camera drive. Synchronous motor drive is the most accurate and reliable, but under present-day conditions in this country, the frequency of the public A.C. mains cannot be relied upon and often falls considerably below the standard 50 cycles per second.

For 16 mm. cameras a new synchronous motor has recently been marketed in this country and can be had either for 24 or 16 frames per second.

Method C. Timing marks on the actual film. Timing marks on the actual film are to be preferred in all cases where high accuracy is desirable, but this method entails some modification of the camera.

Time-marking on Film

There are several methods of making the time marks, such as the battery operated tuning-fork time-base for the Kodak High-Speed Camera, and simpler time markers using larger tuning-forks which can be arranged to generate small sparks which are photographed on to the film. The accuracy of the tuning-fork method is high and is particularly suitable for high-speed cameras.

A simple and relatively crude method of time-marking on the film is to use a small gas discharge tube, as is now embodied in the latest Eastman high-speed camera.

If the discharge tube is operated from the supply mains, as it is intended to be, the remarks made above concerning the accuracy of the supply frequency also apply here. Operation from A.C. mains may also be a disadvantage if work has to be done in the field. This method of time-marking for a high-speed camera is much inferior to that given by a tuning-fork, and also much less convenient in the subsequent analysis of the films.

In the Kodak time-base, by using a 500 c/s tuning-fork, the marks appearing on the film are spaced at intervals of one millisecond. Each mark is only a few millimetres length and at 3,000 pictures per second there will be approximately three frames between two marks. With the East-

man gas discharge tube, however, there will be only 100 flashes per second (on 50 c/s supply mains) and at a camera speed of 3,000 pictures per second there will be about 30 frames between two marks. The marks themselves are very long and drawn out, and have ill-defined ends. Each mark covers about 16 frames at 3,000 pictures per second.

If the camera is used on 60 c/s supply mains, as in the U.S.A., there will be 120 marks per second, which corresponds to an approximate time interval of 8.3 milli-

at the appropriate moment. At high camera speeds filament lamps are quite useless, and a gas discharge tube operated on D.C. is essential.

7. Apparent Speed can be varied

A. The camera runs faster than the projector. The original work of both Muybridge and Marey in 1880 was concerned with taking photographs at short intervals of time in order to *analyse* the motion recorded, giving what is now known as the slow-motion film.

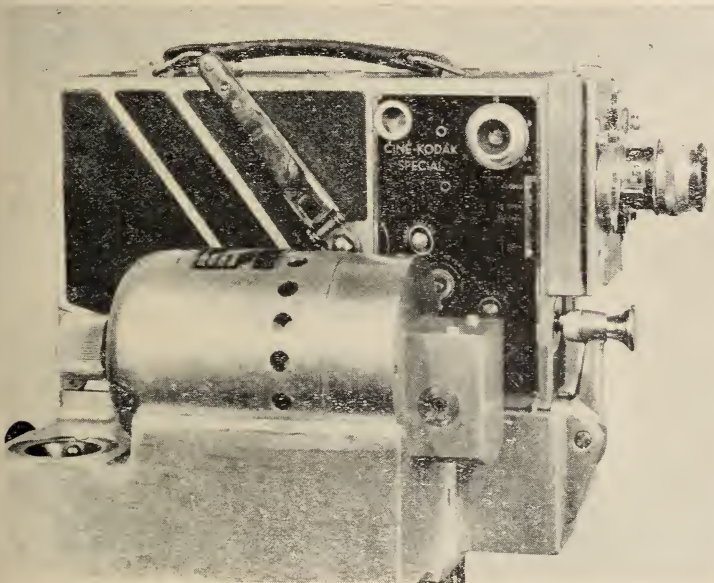


Fig. 2. 16mm. Cine-Kodak Special Camera driven by Synchronous Motor made by W. Mackie & Co. Ltd.

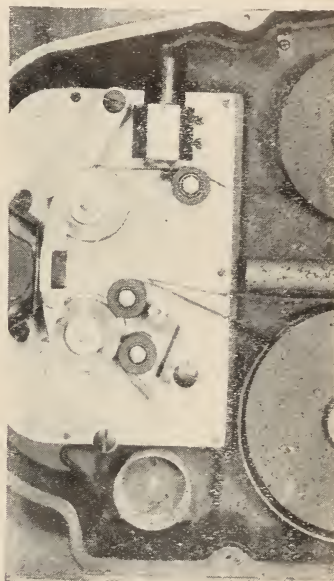


Fig. 3. Interior of Eastman High-Speed Camera showing Housing for Flashing Lamp used as Time-base.

seconds for each successive mark. The long ill-defined marks and this unusual time-interval must be very inconvenient in the analysis of the films.

Any time-base should give marks of short duration, small size, high-brightness, convenient time-interval and of unquestionable accuracy.

In certain work, the exact moment of commencement of an event requires to be accurately recorded, and this is somewhat less easy to achieve. The simplest method is to include a lamp in the field of view of the camera and to arrange the lamp to light

Many special cameras have been made for this work,⁴ but those most usually met with for general research work are the Eastman high-speed camera and the Western-Electric "Fastax." The Eastman camera (with millisecond time-base) seems to be preferred in this country and is a reliable and fairly portable equipment.

The author has used one of these cameras for several years and for a very great variety of investigations, and it is interesting to note that at first the work usually involved large machines with consequent difficulty of lighting large areas, whereas more recently

there has been a marked trend towards the examination of very small mechanisms, with the attendant difficulty of lighting very small objects efficiently and of positioning the camera with the required accuracy. In the author's laboratory use is made of special stands which enable the camera—or the object—to be positioned with ease. For fields down to the size of a matchbox, the Kamm stand⁵ is excellent, particularly if the camera has to be held over part of a large machine. For smaller areas either the camera or the object is mounted on the compound slide-rest of a lathe. In this way,

and the author uses two 350-watt 26-volt lamps in reflectors 8 ins. diameter. When properly focused, these lamps will illuminate an area about 2 ins. diameter to a brightness, on a white card, of 70,000 foot-candles. Lamps of this type generate considerable heat and concentrate it in a small area, so that precautions must be taken to avoid damage to the object under investigation.

For smaller areas still, say, 3 to 5 millimetres, the compact-source mercury-vapour lamp is very useful.⁷ To avoid stroboscopic effects, it is necessary to operate the lamp on D.C., which entails special starting and

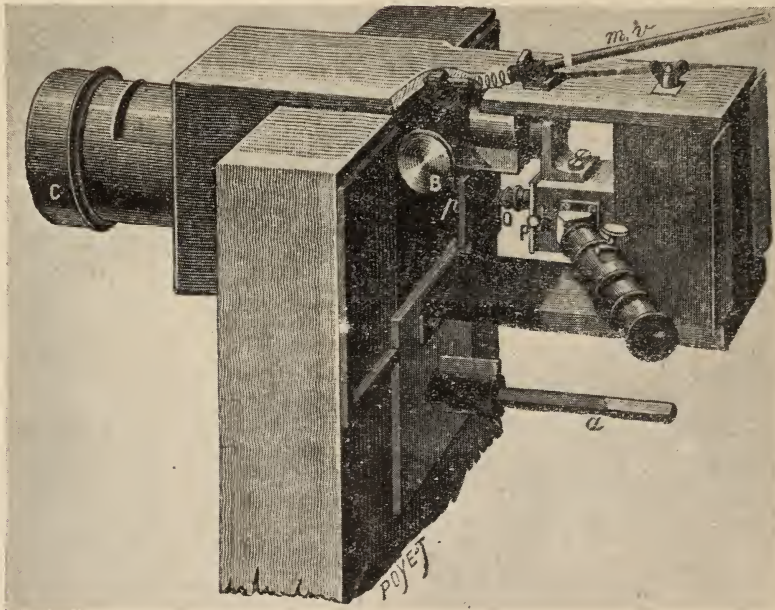


Fig. 4. Marey's Apparatus, with Microscope, for the Study of small Insects in flight.

positioning is possible in three dimensions to one-tenth of a millimetre, with ease and certainty.

Lighting Problems

Recent developments in gas-discharge lamps, for example, the Mole-Richardson "Cineflash" equipment,⁶ have solved some of the problems of lighting large areas, but this apparatus is not suited for small objects. For small fields, one of the most convenient arrangements is to use high-wattage low-voltage filament lamps in efficient reflectors,

control circuits, but the very high brightness, small area, and lack of heat make the equipment indispensable for many types of work. In addition, the author also uses a small D.C. arc focused accurately on the object. The arc generates some heat, but it is easily removed with suitable filters, and with both lamps in use at the same time, no heating troubles have been met with. The two lamps will illuminate an area 3 mm. x 5 mm. to an estimated brightness of about 175,000 foot-candles.

In lighting very small machine parts, some

degree of specular reflection is permissible, and is often essential, to make good use of the available light, whereas such reflections are usually avoided in normal photographic work.

B. The camera runs slower than the projector. The converse of high-speed photography is time-lapse work, in which case the camera is run less quickly than the projector. It appears that Marey was again the original

of a local generator, and this equipment is expensive and does not eliminate the risk of a complete power failure.

8. Invisible Radiations

The use of invisible radiations is at present restricted to a small number of highly specialised fields, but the results obtained are of considerable importance. A number of workers have used infra-red radiation, and

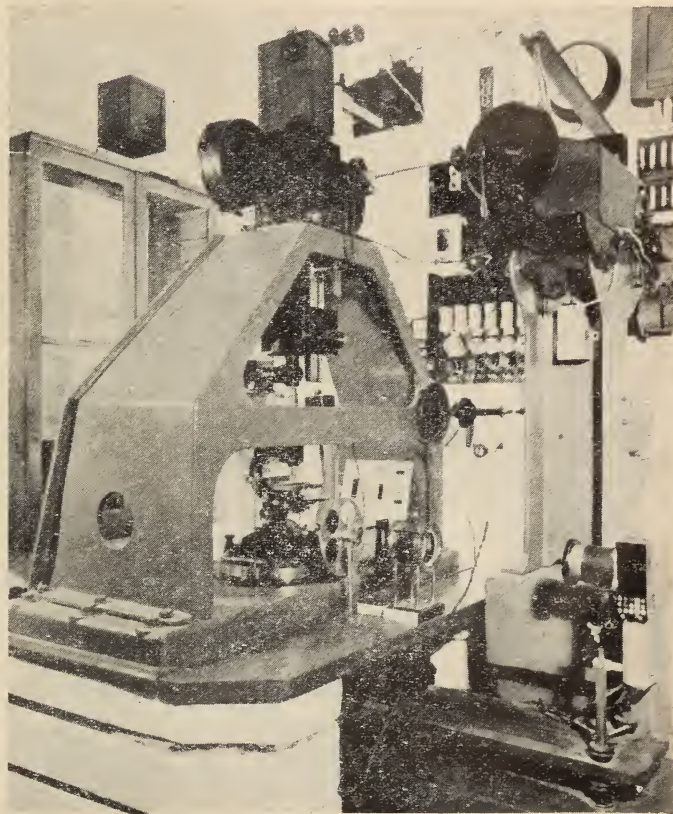


Fig. 5. The Apparatus of the late Dr. Canti now at Cambridge.

worker in this field. He accelerated and synthesised the slow movements of the starfish by making separate exposures at intervals of one minute.

The technique is of great value for research, but one of the major difficulties of workers in this country is the instability of the public supply mains, as voltage variations interfere seriously with lighting during protracted runs. The only solution to this problem appears to be automatic stabilising

kine-radiography has been practised for many years. More recently, ultra-violet radiation has been used for the study of living cells, but no films have yet been made with ultra-violet. It remains to be seen if this is a practical possibility or whether the radiation will kill the cells.

In all this work, very special equipment is necessary, and the economic factor has had a limiting effect on the amount of work that can be undertaken, but one looks for-

ward to the extension of the work into other fields of research.

The Camera and the Microscope

Since the microscope is a universal research tool, it is natural that a large number of research films should have been made with its assistance. Again, Marey in France appears to have been the pioneer worker, and his book "Movement" contains an illustration of his special microscope.

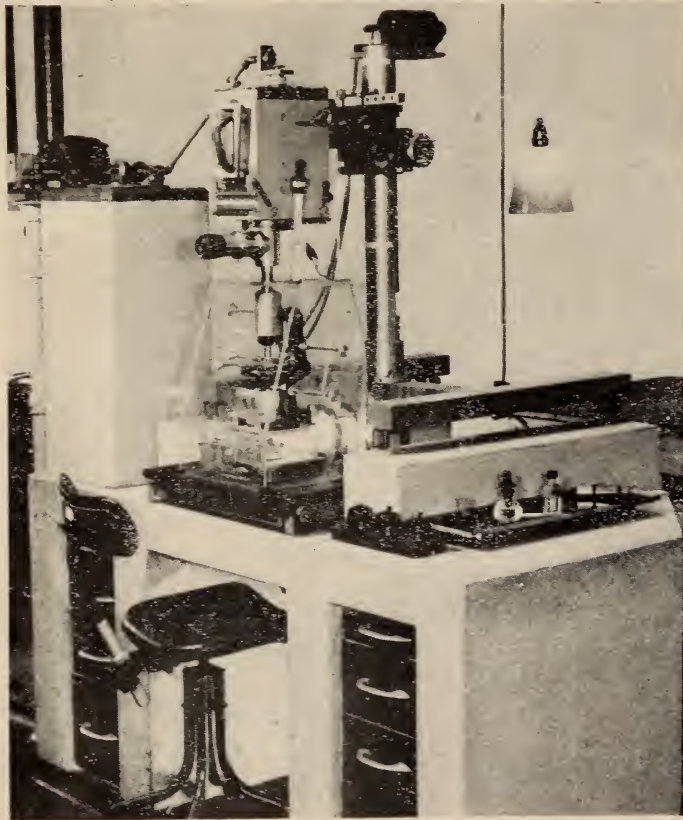


Fig. 6. The Apparatus of Simpl, Ltd.

The majority of films made with the microscope have been time-lapse records of cell growth and cell division. The method has the advantage of saving much time and, for organisms that grow slowly, the tireless automatic operation of an equipment for kinemicrography may be the only method available for certain types of research work.

Since no commercial equipment is available for this work, each worker has had to

design and construct his own apparatus, and this may be complex and expensive.⁸

The basic component parts of every kinemicrographic equipment are as follows:—

1. The microscope with its thermostatically controlled incubator.
2. The illuminating system and protective shutter.
3. The motion picture camera and special observation ocular.
4. Rigid support for the camera with anti-vibration mountings.

5. Camera drive motor and single-turn clutch.
6. Timing unit to operate the camera at the correct time intervals.

The equipments of Dr. Commandon at L'Institut Pasteur and those of the late Dr. Canti, now at Cambridge, are of this type, but recently less massive and expensive apparatus has been used by some workers, notably Dr. Hughes of Cambridge, and it is now possible to make a reliable 16 mm.

equipment for a comparatively modest expenditure.⁹ Earlier workers, such as Dr. Commandon and the late Dr. Canti, used the conventional microscope with both light- and dark-ground illumination, but neither method was all that could be desired for that difficult object, the living cell. The recent development of the phase-contrast microscope has revolutionised the study of the unstained and living cell, and this has

great advantage over 35 mm. film. With suitable emulsions, the resolving power of the microscope with a 16 mm. camera need be in no way inferior to work done on 35 mm. film, and about one-eighth of the light may be used. Standard 35 mm. film may possess some advantages when working with low magnifications and large fields, in which case very much less light is necessary and the risk of cell damage is small.

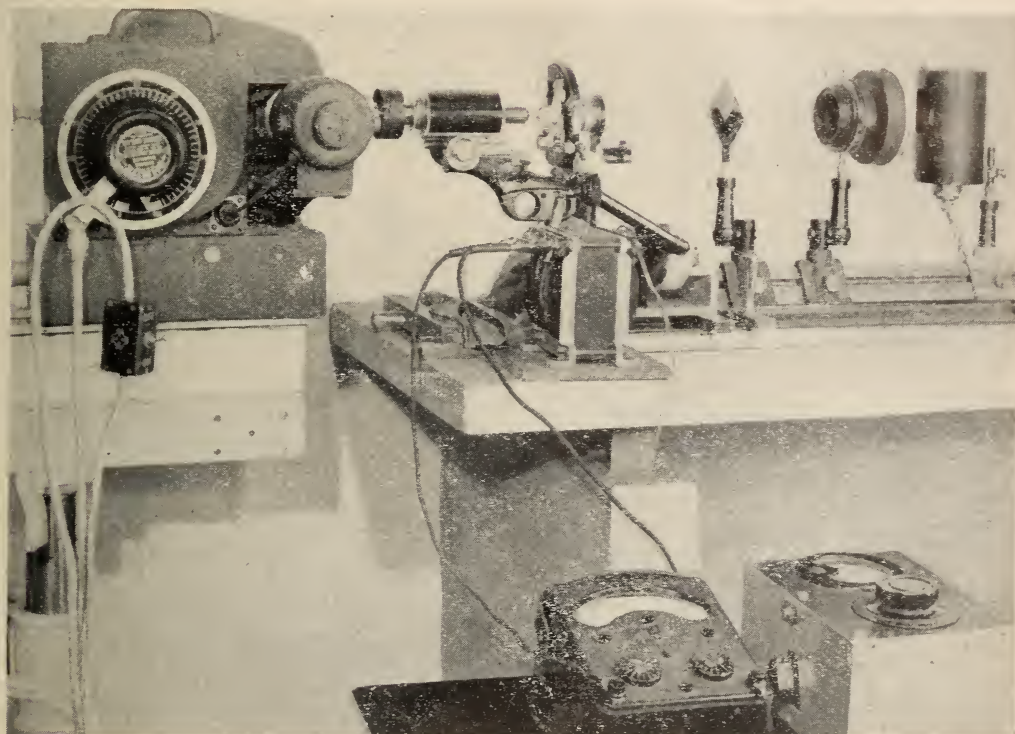


Fig. 7. High-speed Camera Set-up for use with the Compound Microscope.

brought about a renewed interest in films made with the microscope.

The 16mm. Film

The use of 16 mm. film for this work is not to be considered an economy or as a second-best, but as a technical necessity.

Since living cells are very sensitive to radiant energy, and may indeed be killed by it quite easily, it is essential to work with the smallest possible projected microscope image, as the small image will be brighter than a large one, and 16 mm. film offers a

A few workers only have used the microscope with the high-speed camera, as the technical difficulties and cost are increased. Professor Otto Storch, of Vienna, has studied the movement of cilia and ciliated organisms, using camera speeds up to about 120 pictures per second, and the author has recently done some work up to 3,000 pictures per second, but in this case the magnification was not high and no difficulty was experienced in obtaining sufficient illumination.

Since the microscope increases the apparent velocity of a moving object, the increase

being proportional to the magnification, each increase in magnification necessitates increased camera speed, and the limit of camera speed may soon be reached in certain cases. Increase of magnification also requires increased illumination, but difficulty is not expected in this direction except at high powers, and little work has been done in this field.

Conclusion

The above remarks form a brief résumé only of the advantages, uses and methods of using the film in research, and it is anticipated that as these become more widely appreciated, both by industrial and scientific research workers, the film will assume an increasingly important position in the equipment of the investigator.

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DISCUSSION

MR. L. TOWNES: I notice your films have very fine grain. What stock do you use?

THE AUTHOR: Super-X reversal film. There would be no difficulty in securing more light if we wished to use a finer-grained emulsion.

MISS THORA JAMES: Is there any possibility that public money will be available for making films of this type?

THE AUTHOR: I do not know of any funds that provide money for this work. Films can be divided into two categories: industrial and research. The interesting things like penicillin, thermometers and watches are more academic, and there is not much money available. We are making some films for television, the reason being that television cannot employ time-lapse methods.

MR. BLAY: Has the sound film any application in research other than for commentaries?

THE AUTHOR: I do not know of any.

MR. L. KNOPP: Recently I saw a film at the Royal Society, taken by the Official Astronomer of the Académie Française, of atomic disturbances on the surface of the sun, and the pictures were synchronised with short-wave interference signals received through a normal radio set.

MR. R. H. CRICKS: A high-speed camera now being made has provision for recording vibrations associated with certain phenomena. Recently we saw a remarkable American film showing the beating of a fly's wings, taken with high-speed flash.

THE AUTHOR: I have no experience of stroboscopic illumination. My impression is that there is often a considerable variation in intensity of the light—the flashes are not uniform. The necessary equipment is probably exceedingly expensive. It is simple to make an electric circuit that will discharge every half-minute, but a rate of 3,000 flashes per second necessitates very bulky equipment.

An application of sound that I had forgotten to mention was in recording the action of the tongue in speech. A patient had lost nearly all his cheek, and the action of the tongue was filmed at high speed, and the man's speech was recorded, per-

mitting the therapists to analyse the film with a complete sound track.

MR. BLAY: For timing, have you considered the use of a medium frequency oscillator, perhaps 1,000 c/s, for recording on the film?

THE AUTHOR: I think it is probably a more complicated method than the tuning fork, which is relatively simple, and works off a 12v. battery, with no valves.

MR. HAYBITTLE: Recently I saw a demonstration of the electro-myograph, which records on tape the voltage that is produced in a muscle. The record is fed to an oscillograph, and the oscillograph is photographed.

MR. CLARK: In the film on bacteria there were some smaller bodies which remained active. Do you know what they were?

THE AUTHOR: I think they were very small particles moving about by Brownian movement in the liquid. They were not necessarily living organisms.

MR. N. LEEVERS: I was very impressed with the use of the film in showing the performance of high-speed mechanisms. In this industry we have a particular interest in that. One of the bugbears of cinematography is the acceleration and deceleration involved in the camera and projector. As far as I know there has been very little effort to discover exactly what happens in a camera gate under working conditions. The high-speed film seems the ideal medium to study it.

THE AUTHOR: So far as I know there has not been much work on the subject in this country. I remember a paper in the *S.M.P.E. Journal* on the action of the film in the gate of a projector and the effects due to heat.

MR. L. TOWNES: In running high-speed cameras, do you get any trouble with heat generated frictionally in the camera?

THE AUTHOR: No, it is all over too quickly. The thing that would get hot is the motor; it is a 32v. motor run on 110v. We can take twenty runs in a morning and the motor does not even feel warm,

PREFERRED METHODS OF PRODUCING FILMS FOR 16mm. RELEASE

The meeting of the Sub-Standard Film Division on October 11, 1950, was devoted to a discussion of the production of 16mm. prints.

Mr. Norman Leever, B.Sc., A.C.G.I. (Fellow), opening the Meeting, explained that the discussion was to form part of the work of the Technical Committees set up by the Division.¹ The discussion was opened by Mr. Dennis Cantlay (Member) who read the following statement prepared by the Divisional Committee.

THIS discussion is limited to those cases where the number of release prints required will be at least 25 and possibly up to 100 or more. Those special cases where only half-a-dozen or so prints are required are outside our present scope. As far as possible, the problems associated with picture, and those peculiar to the sound track, will be discussed separately.

Monochrome Films

The first factor which will have a bearing on the method of producing the final prints is whether the film is to be shot on 35 mm. or 16 mm. stock. If one or more 35 mm. prints are likely to be required, the film must obviously be made on 35 mm. in the first place. If only 16 mm. release prints are wanted the decision will probably depend upon the equipment facilities available to the producing unit.

For a film of the highest possible technical quality with all the tricks and refinements of the feature film, 35 mm. film must be used for the very simple reason that the necessary 16 mm. equipment does not exist. Further, in this country at the present time, the 16 mm. cameras and lenses which are equivalent in performance to the average good 35 mm. camera can be counted on the fingers of one hand. This statement will no doubt be challenged, but refers to picture quality of the highest order, and not adequate quality.

Many producers are fully equipped to handle 35 mm. films, and in such cases it is obviously to their advantage to use their existing cameras and cutting-room equipment. It may be mentioned at this point that as a general rule, financial saving in making a film on 16 mm. stock as against

35 mm. stock is very small, being only the saving in cost of the stock itself. The major items, labour charges, lighting, etc., do not vary for films of the same quality, whether they be 16 mm. or 35 mm. Nevertheless, many films are now being produced originally on 16 mm. film, and no doubt the proportion will be greater in the future.

We therefore have to face the possibility of having to make prints either from 16 mm. negatives or from 35 mm. negatives.² In the former case, the problem is straightforward, as ordinary contact prints can be obtained in the usual way. Of course, the obvious precaution of making a duping print should be observed before quantity printing is started, and often it is an advantage to print from a duplicated negative which is graded, rather than from the ungraded original negative.

In the case of the 35 mm. negative, the most popular method at the present time is to obtain prints by means of optical reduction. Here again, better results are obtained if graded duplicate negatives are employed. There are, however, other methods which can be followed, and one in particular is becoming popular by virtue of the saving in costs when a large number of prints are required, coupled with the fact that the final print itself can be as good as that obtained by reduction printing. This method is to produce a 16 mm. negative by optical reduction methods from a 35 mm. duping print, and to take off contact prints in the ordinary way.

Colour Films

Only the two most commonly used colour systems, i.e., Technicolor and Kodachrome, will at the moment be considered.³ In the

case of Technicolor, the user has no choice as to the method employed to produce his prints. The 16 mm. picture is printed on to 35 mm. stock, which is then split and perforated to 16 mm. standard dimensions. While this method wastes over 50 per cent. of the stock used, it is probably the only solution, as it would appear to be almost impossible to obtain the accurate registration necessary with singly perforated 16 mm. sound stock.

Kodachrome, being a reversal process, has the disadvantage of being able to produce only a limited number of prints, if correct colour rendering is to be maintained. It is possible to produce some second generation prints, i.e., a print from a print which has been taken from the original, this being equivalent to using a duplicate negative. With second generation prints, however, there is a marked loss in colour values. In the event of one hundred or more 16 mm. colour prints being required from a Kodachrome master print, Messrs. Technicolor can, provided it is of good quality, produce them by working from the original Kodachrome in the first place.

Printing the Sound Track

As in the case of printing the picture, we may have to obtain our 16 mm. sound track in the first place either from a 35 mm. or a 16 mm. negative.⁴ Whatever the track, it must be recorded with corrections introduced to compensate for 16 mm. printer losses, and to make it suitable for projection in acoustically inferior auditoria.⁵ This correction may include bass cut, mid or high frequency tip-up, and volume compression, but the amount and type of correction introduced should depend upon the sound track itself. For instance, the amount of tip-up necessary for certain voices would be different from that for others. Furthermore, the high frequency cut introduced for a sound track to be used in a Kodachrome film would

be lower than that necessary on chrome film.⁶

Having obtained a suitable negative, final release prints can be obtained by contact printing from a 16 mm. negative, or reduction printing from a 35 mm. negative. The final quality of the 16 mm. print depends so much upon the printer used, the processing, and general laboratory handling, that no one method can be generally assumed to be better than another. Reduction prints, which are infinitely superior to contact prints, may be obtained from a certain laboratory, while the reverse will apply in the case of another laboratory.

In those cases where a few 35 mm. prints of the films are required, and the film is of a straightforward type, adequate 35 mm. prints can be obtained from a negative which has been corrected for 16 mm. prints. The quality is of course not as good as if a standard 35 mm. negative were used, but it is adequate, and in most cases, the cost of recording a special track for a few 35 mm. prints is not an economical proposition. In these cases, it is usually best to obtain the final 16 mm. release prints from a 35 mm. track by reduction printing.

Mr. Leever presented a most valuable demonstration. Two members of the Division had, he said, produced a film in the Dutch East Indies on reversal stock. Copies had been made by duping direct from the reversal master. Subsequently a 35mm. film had been made, with fresh commentary, and contact prints made for theatre release. Because the second commentary was preferred, the film had again been reduced to 16mm. The following films were projected:

- (1) 16mm. reversal dupe, taken direct from master.
- (2) 35mm. contact print, taken from "blown-up" negative.
- (3) 16mm. optical reduction print, taken from "blown-up" negative.

The view was expressed that the 16mm. reduction print showed superior quality to the original dupe.

REFERENCES

1. *Brit. Kine.*, 17, No. 3, Sept. 1950, p. 92.
2. *Brit. Kine.*, 12, No. 2, Feb. 1948, p. 51.
3. *Brit. Kine.*, 14, No. 2, Feb. 1949, p. 43.
4. *Brit. Kine.*, 15, No. 4, Oct. 1949, p. 116.
5. *J. Soc. Mot. Pic. & Tel. Eng.*, 53, No. 4, Oct. 1950, p. 354.
6. *J. Soc. Mot. Pic. & Tel. Eng.*, 54, No. 3, Mar. 1950, p. 377; 55, No. 1, July, 1950, p. 45.

DISCUSSION

ON T. RUDD considered the economics of production of 35 mm. or 16 mm. He pointed out that approximately the same amount of equipment was required, but that 16 mm. equipment was more portable. He suggested that when 16 mm. equipment is only where required, it was better to use 16 mm.

Mr. LEEVERS differentiated between studio and location production, and between entertainment films and films of an industrial or scenic nature. The portability of equipment and of film stock might make 16 mm. advantageous.

Mr. RONALD RILEY mentioned that in a recent foreign location there had been a choice between Technicolor and Kodachrome. Production costs might have been doubled by the use of Technicolor, the additional costs including, of course, the Technicolor crew.

Mr. GEORGE SEWELL stated that his work lay largely in factories. A large proportion of his equipment consisted of lights; the proportion represented by camera gear was insignificant, and in the main, the amount of equipment was comparable, whether for 35 mm. or 16 mm. In technical films, however, 16 mm. equipment was much more fluid and subjects might be more accessible than with cumbersome 35 mm. equipment.

Mr. R. H. CRICKS suggested that greater use should be made of reversal. For a single copy, reversal processing had obvious advantages; for a hundred copies, negative/positive might be preferable. At what point did reversal processing cease to be superior?

Mr. LEEVERS pointed out that there was, in this country, only one laboratory undertaking reversal printing. His own impression was that the reversal process was capable of producing an excellent original and it was possible to get satisfactory dupes, but the process constituted, in effect, a development, printing and re-development process in one emulsion, and very exact control was necessary at every stage—far more exacting because the three stages were combined in the one film.

Mr. SEWELL agreed that reversal duping was capable of a fair number of copies; the crux of the problem occurred when a large number of reversal dupes was required from a Kodachrome original, but it was possible to get fifty or sixty copies without degradation.

There was one respect in which reversal duping showed an advantage: "sparkle" was inevitable in any negative/positive process, and was exceedingly difficult to eliminate. In reversal, on the other hand, the effect appeared as black spots, which were not so offensive.

Mr. E. M. GREENWOOD objected that the only colour processes so far considered were Technicolor and Kodachrome. He submitted that in

view of developments now taking place in other colour processes, such processes should be taken into consideration.

Mr. CANTLAY, stressing that the proposed investigation must have a scientific basis, objected that the 35 mm. and 16 mm. films were shown at different light intensities, and could not, therefore, be accurately compared. He mentioned the difference in procedure between making reduction prints from a 35 mm. negative and by contact from a 16 mm. negative; the latter, he stated, was used almost exclusively by one of the largest laboratories.

Referring to Mr. Greenwood's remarks, Mr. LEEVERS stressed that there was no intention to restrict the investigation to the colour processes mentioned. Replying to Mr. Cantlay's earlier remark, he agreed that the demonstration was not scientifically correct but was submitted for the purpose of formulating ideas for discussion.

Mr. CANTLAY mentioned a problem relating to the choice of method of producing prints: that the owner of a film might initially order only a few prints, and continue to place small orders. If an idea were first given of the total number of copies likely to be required, the production of a 16 mm. negative could be considered in the first place.

Mr. DAVIDSON pointed out that the majority of laboratories were prepared to supply either optical or contact prints, as required.

Mr. WALTER LASSALLY raised the problem of the production of prints from sub-titled originals; ninety per cent. of sub-titling became illegible. He asked what was the best method of producing prints from a sub-titled 35 mm. copy?

Mr. DAVIDSON stated that in superimposing titles in Chinese it had been necessary to use a black mask. He agreed that the results were rarely satisfactory. Replying to enquiries, Mr. DAVIDSON explained the difference between photographic titling and sub-titling produced by etching. Mr. SEWELL stated that certain fonts of type were not suitable, the serifs and finials causing difficulty. Mr. DAVIDSON pointed out that only one font of type was available.

Mr. CRICKS mentioned that at least one laboratory was capable of superimposing sub-titles optically during contact printing.

Mr. LEEVERS recalled that it had been previously recommended that a dupe should never be made from a show copy.

Mr. D. G. DAGGETT, commenting on the high quality of the 35 mm. enlargements, asked for an explanation of "sparkle." Mr. R. H. BOMBACK explained that it was due to dust on the film printing through, although Mr. SEWELL pointed out that it might be due to the emulsion. He pointed out that in reversal the effect was to cause black spots, which would be less noticeable. Mr.

HISSEY commented that the effect was aggravated by optical printing.

Replying to a visitor, who objected that the discussion was being extended to 35 mm. production, Mr. LEEVERS pointed out that account must be taken of the large number of films shot in 35 mm. and released in 16 mm.

Mr. BOMBACK enquired the reason for the preference for working in 35 mm. Mr. LEEVERS suggested that among other factors were facilities for optical work in 35 mm., which could otherwise be produced from 16 mm. only by enlarging to 35 mm., optical printing, and reducing to 16 mm.

Mr. GREENWOOD, agreeing that lack of 16 mm. equipment was a serious disadvantage, mentioned also the limited choice of stocks as compared with 35 mm. There had not, he said, been the same development in positive and negative stocks, for which reason it was customary to shoot 16 mm. on reversal stock.

Mr. G. CRAIG disagreed with this view and said that, so far as Kodak materials were concerned, Plus-X picture negative was available in 16 mm., although Super-XX was available only as a reversal stock, since the coarser grain of a faster film tended to rule it out. As regards positive films, there was no restriction whatever; exactly the same materials were available in 16 mm. as in 35 mm. The same applied to duping negative; the fact that duping positive film was not available was due to the extremely limited demand. A satisfactory master positive could be produced on one of the regular positive materials. The real shortage of choice in 16 mm. lay in sound recording films, in which 35 mm. offered a wider variety.

Mr. W. S. BLAND expressed preference for the method of making a 16 mm. sound track by direct recording and contact printing. He agreed, however, that the obstacle mentioned by Mr. Cantlay, of uncertainty as to how many prints would be required, made this method at times uneconomical. Although in his own Company's laboratory optical reduction of high quality was the rule, certain customers showed a marked preference for direct recording. The ultimate quality obtainable by direct recording was governed by printer design. Mr. LEEVERS expressed the view that contact printing was in general superior to optical reduction, and Mr. BLAND thought there was less consistency in the latter process, particularly at lower sound levels. He mentioned that with variable area recording the fine grain sound recording negative gave vastly improved results over the former No. 5301.

Mr. LEEVERS spoke of his own uneasiness in recording a 35 mm. master track compensated for 16 mm., unless he was able to specify the laboratory where it was to be handled. Replying to Mr. Bomback, Mr. LEEVERS amplified his views by explaining that while the signal-to-noise ratio might be low, some concern was expressed with

regard to intelligibility of speech and absence of distortion; these factors were no doubt due to so many 16 mm. prints being projected in noisy auditoria.

Mr. A. M. SMITH, disagreeing with previous speakers, said he had found optical reduction generally more consistent than contact printing.

A visitor pointed out that in reducing to 16 mm. from a normal 35 mm. track there must inevitably be high frequency losses in processing. Further difficulties might be caused by inferior loud speakers and acoustics. Direct recording or re-recording gave an opportunity to adjust frequency response and equalise to bring up the mid-frequencies.

Mr. LEEVERS raised the point that variable density recordings were less liable to distortion in optical reduction than the area system. Mr. BLAND, pointing out that this factor was dependent upon the optical reduction printer, stated that on the type of printer which produced two tracks, side by side, there was great freedom from distortion. A more serious cause of distortion in the variable area track was the uneven illumination of the reproducer slit, which was probably one of the most serious variables that had to be overcome. In his view, too, optical reduction, besides being "bassy," usually showed some flutter. Mr. LEEVERS suggested that in many optical printers the exposure along the slit varied over wide limits, which fact naturally produced some distortion in the track, but to a negligible extent in the case of a density track.

He suggested that where the majority of release prints were required in 16 mm. but the track was to be recorded in 35 mm., the recording might be compensated for 16 mm., which would normally give satisfactory reproduction in the type of theatre in which the 35 mm. would be commonly shown, although it might be rather fatiguing to listen to for any length of time, due to the pre-emphasis of the high frequencies necessary to secure subsequent 16 mm. copies.

A visitor referred to the difficulty of securing a consistent series of prints in Technicolor from Kodachrome by means of reduction. He preferred the method of re-recording to a negative and contact printing. Mr. LEEVERS agreed that a master positive track for use with Kodachrome must be specially produced.

Mr. P. G. CHASE expressed preference for direct 16 mm. recording, although an obstacle was the small number of recorders available. He had found in the case of tracks for Kodachrome that a difficulty was the inadequate contrast in an area track. It had been stated, he said, that a minimum density of 1.6 was necessary to produce a fairly silent background, and he had received tracks with a density of only 0.5. Of two optically reduced tracks he had recently received, one showed a density of .99 and the other of .68.

Mr. RILEY suggested that part of the fault in sound quality lay in the diction of artistes. Mr. CRICKS agreed with this point, and objected to the use of background music; it was undesirable on 35 mm. and far worse on 16 mm.

Mr. LEEVERS agreed that it needed extraordinary skill to add background music to 16 mm. Mr. HISSEY suggested that the director should hear, for comparison, 35 mm. and 16 mm. reproductions, since the average reproduction quality of 16 mm. equipment was far below that of 35 mm. Mr. MATT RAYMOND claimed that a very large percentage of 16 mm. projectors gave reproduction quality up to 35 mm. standards.

Mr. LEEVERS described the method he used to enable the director to hear the effect of his recording. The original material was recorded upon a magnetic tape, which was played over before transferring. In almost every case the director would approve unsuitable material because he could not visualise the effects of further processing, of transfer to 16 mm. and reproduction on 16 mm. equipment. The skill and experience of the recording engineer must be the guiding factor. The use of magnetic recording in this matter gave the added advantage that a decision as to whether it should be transferred to 35 mm. or 16 mm., or both, could be deferred to the last moment.

Mr. BLAND, while approving this method, objected that often a director would over-ride the views of the recordist and later express dissatisfaction at the resultant quality. Mr. LEEVERS thought that the professional director was not often an offender in this respect. The real offenders were amateurs and semi-professionals, who often ignored the advice of the recordist and yet had insufficient experience to judge matters for themselves.

Mr. CHASE enquired whether a certain voice might be unsuitable for recording, due to its extending above a certain frequency. Mr. BLAND suggested that a more serious problem was the use of dialect speakers whose speech would be incomprehensible to two-thirds of the people in the country. Another requirement was that people should speak out. He did not think that a high frequency range had much effect upon quality, although he had experienced trouble with excessively bass voices. In feature productions there was a tendency for artistes to whisper; this was even worse in the case of documentaries, where often there was not the advantage of synchronous lip movement to assist comprehension of dialogue. He urged that some standard of recording quality should be set up for 16 mm.

Mr. SMITH stressed that for 16 mm. recording artistes must speak more clearly and more slowly.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

FIFTY YEARS OF KINEMA

I. Landau, L. Lobel, G. Mareschal, H. Piraux, G. Lechesne, A. Bruyneel, A. O. Guibert and R. Barkan, *Tech. Ciné*, July/Aug. 1950.

A survey of technical developments in the French industry, covering studio, laboratory and kinema.

R. H. C

STRESS RESEARCHES ON PERFORATIONS

H. Voigt, *Foto-Kino-Technik*, Aug. 1950, p. 243.

Stress patterns in a model of a film perforation are used to assess the stress upon the perforation edge caused by different forms of sprocket teeth.

R. H. C.

A REFLEX 35mm. MAGAZINE MOTION PICTURE CAMERA

A. Coutant and J. Mathot, *J. Soc. Mot. Pic. & Tel. Eng.*, Aug. 1950, p. 173.

A detailed description of the Camerette reflex camera (formerly known as the "Caméflex"—see this journal, 14, No. 6, June 1949, p. 178).

DESIGNING ENGINE GENERATOR EQUIPMENT FOR MOTION PICTURE LOCATIONS

M. A. Hawkins and Peter Mole, *J. Soc. Mot. Pic. & Tel. Eng.*, Aug. 1950, p. 197.

Engineering factors involved in the design and construction of portable lighting generators are evaluated. A 120 v. D.C. generator with a two-wire output of 750 amps. to 1,400 amps. will satisfy most load requirements. For special cases and colour work, larger loads up to 2,500 amps. may be required, and if supplied from a single generator unit, 3-wire system is preferable. Prime mover may be petrol or diesel engine. Requirements of noise control, portability, ripple voltage, protective devices and maintenance are described. Details are given of a 150 kW power unit contained in a portable cubicle, suitable for loading on a truck or trailer.

B. H.

FLUTTER MEASURING SET

F. P. Herrnfeld, *J. Soc. Mot. Pic. & Tel. Eng.*, Aug. 1950, p. 167.

With the latest proposed standards for flutter in view, the apparatus is designed to provide means of measuring low values of flutter at rates up to 200 c/s, with considerable accuracy and freedom from drift. The carrier frequency is 3,000 c/s., and filters enable the bands 0-2, 2-20, 20-200, and 96 c/s. to be investigated separately.

N. L.

THE "EXPRESSOR" SYSTEM FOR TRANSMISSION OF MUSIC

R. Vermeulen and W. K. Westmijze, *Philips Tech. Rev.*, April 1950, p. 281.

The authors discuss in some detail several aspects of the signal-to-noise ratio of a system and its bearing on volume range. Methods of increasing signal-to-noise ratio are then set out, and the application of compression-expansion to a Phillips-Miller installation, using the control track principle, is described and illustrated.

N. L.

DEBRIE SOUND REDUCTION PRINTER

Bull. de l'Assoc. Franc. des Ing. et Tech. du Cinéma, 1950, No. 8, p. 15.

The "Tipro Ris-2" printer reduces the sound track from 35mm. to twin-16mm. film; the use of an anamorphic system is avoided by projection upon each 16mm. track of a duplicate image of the 35mm. track. The two films are driven by co-axial sprockets.

R. H. C.

CRISTIANI SYSTEM OF COLOUR AND STEREOSCOPY

Bull. de l'Assoc. Franc. des Ing. et Tech. du Cinéma, 1950, No. 8, p. 8.

By means of a four-cornered pyramidal prism, four separation images, taken respectively through blue, yellow, red and green filters, are produced in the space of a single normal 35mm. frame, and are projected additively. For stereoscopy, the right- and left-hand pairs are projected and viewed through polarising filters.

R. H. C.

A NEW HEAVY-DUTY PROFESSIONAL THEATRE PROJECTOR

H. Griffin, *J. Soc. Mot. Pic. & Tel. Eng.*, Sept. 1950, p. 313.

The Simplex X-L 35 mm. projector embodies reduced mechanical load on the gear train; automatic lubrication; conical shutter; lens mount accommodating 4in. diameter lenses; built-in change-over unit; 24-tooth continuous sprockets; and air cooling of the gate.

R. H. C.

A NEW DE LUXE 35 mm. MOTION PICTURE PROJECTOR

H. J. Benham and R. H. Heacock, *J. Soc. Mot. Pic. & Tel. Eng.*, Sept. 1950, p. 319.

The design of the RCA-100 projector is based upon that of the Brenkert BX-80. Features are automatic lubrication; large size Maltese cross; large glass door exposing the whole film path; twin rear shutters; and provision for 4in. diameter lenses.

R. H. C.

PHOTOGRAPHY IN TELEVISION

R. H. Cricks, *Functional Phot.*, Aug. 1950, p. 24.

Film is used in television as part of a programme, and conversely for recording transmissions for subsequent repetition. The mechanical and photographic problems of film transmission are discussed, the work of the B.B.C. film unit is described, also the method of recording transmissions upon film.

AUTHOR'S ABSTRACT.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

A MODERN LABORATORY FOR SOUTH AMERICA

The Laboratories Alex have just been completed in Buenos Aires to meet the needs of South American production; provision is made for processing black-and-white and bi-pack.

Amer. Cine., Jan. 1951.

UNINTERRUPTED TAKING AND PROJECTION OF FILMS

To obviate the interruption of light by the shutter in both taking and projecting, it is proposed to pass a film or two films through two gates at right-angles, an optical system employing

a mirrored shutter serving to expose or project one film while the other is moving.

—*Film-Technikum*, Feb. 15, 1951.

SPANNING THE CONTINENT BY RADIO RELAY

A radio connection now extends from New York to San Francisco, operating in the 4,000 Mc/s range; 105 relay stations are situated at about 30-mile intervals. The Type 416A vacuum triode which makes possible the use of such short wavelengths is the size of a walnut; output power of each station is $\frac{1}{2}$ -watt.

—*Bell Telephone Magazine*, Winter, 1950-1.

THE COUNCIL

Summary of Meeting on Wednesday February 7, 1951, at 117 Piccadilly, W.1.

Present : Mr. L. Knopp (*Vice-President*) in the Chair, and Messrs. E. Oram (*Deputy Vice-President*), H. S. Hind (*Treasurer*), B. Honri, D. Cantlay, F. G. Gunn, T. W. Howard, N. LeEVERS, S. A. Stevens, and R. J. T. Brown (*representing Papers Sub-Committee*).

In Attendance : Miss J. Poynton (*Secretary*).

Apologies for Absence.—An apology for absence was received from Mr. R. E. Pulman.

COMMITTEE REPORTS

Social Committee.—Further arrangements are being made to ensure the success of the Dinner-Dance at Grosvenor House on April 4th. Tickets are available, price 37s. 6d. each.

Theatre Division.—A matter of outstanding importance to the projectionist has been debated, first by the Divisional Committee and second by the Membership Committee. The deliberations resulted in a recommendation the nature of which is set out in the resolution below.—*Report received and adopted.*

The following resolution was moved :—

“That in future Chief Projectionists of four years' standing and having been Associates for a period of not less than three years shall, on submission of suitable evidence of their technical qualifications on the new proposal form, be admitted to Corporate Membership.”—*Resolution put and carried.*

Film Production Division.—The subject matter of most of the papers for the 1951/52 Session had been

agreed. The papers will, in the main, reflect long-term future developments.

The annual Studio Visit this year will take place on April 19th at 2 p.m. at the B.B.C. Television Studios, Lime Grove, and an interesting programme, including a discussion meeting in the late afternoon, is being arranged.

A recommendation was submitted for approval :—

“That consideration should be given by Council to widening the scope of the Society's activities to include television engineers, along the same lines as the S.M.P. & T.E. have done.”—*Report received and adopted.*

Divisional Chairmen.—The Divisional Chairmen were appointed as follows :—

Film Production Division ...	Mr. B. HONRI
16mm. Film Division ...	Mr. N. LEEVERS
Theatre Division ...	Mr. S. A. STEVENS

Annual Convention.—The Annual Convention will take place on May 5 at Film House, Wardour Street, W.1. On this day the Ordinary Meeting of the Society will take place as well as the Divisional Annual General Meetings. It was suggested that a film be shown in the course of the afternoon, to occupy those members who are not interested in attending all the Divisional Meetings.

Proposal and Transfer Form.—A new proposal and transfer form has been adopted and will shortly be in use.

The Proceedings then terminated.

QUALIFICATIONS OF CHIEF PROJECTIONIST FOR CORPORATE MEMBERSHIP

The Council has acceded to the request of the Theatre Division that an adjustment to Standing Orders regarding the qualification of chief projectionists to Corporate Membership should be made.

The former Standing Orders required that only those chief projectionists having exceptional or additional qualifications or technical attainments should be admitted to Corporate Membership. The strict application of this order has debarred some able and experienced chief projectionists of good standing who have been unable to obtain these higher qualifications through extraneous circumstances over which they have no control.

The new Standing Order will permit projectionists who have held the position of chief for not less than four years, and who have been Associates for not less than three years, on submission of suitable evidence of their technical qualifications, to be admitted to Corporate Membership.

It is therefore hoped that those chief projec-

tionists who are anxious to assist in the advancement of British cinematography and to enhance their own status, will take this opportunity which has been offered to them.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

C. H. BELL and LESLIE KNOPP are responsible for the installation work of the kinema equipment in Clarence House. This equipment was the industry's wedding gift to the Duke and Duchess of Edinburgh.

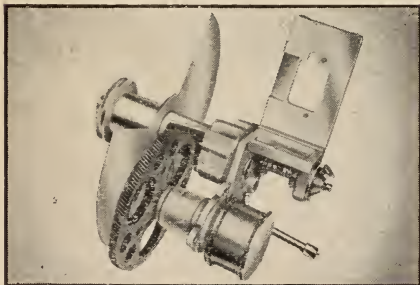
E. GARDINER is now on the Sound Reproduction Staff of the B.T.H. Co., Ltd.

Y. FAZALBHOY, the Society's Indian Representative, will shortly be paying a visit to this country.

DENIS WRATTEN has been elected President, and B. SINKINSON Vice-President, of the Royal Photographic Society, for the ensuing year,

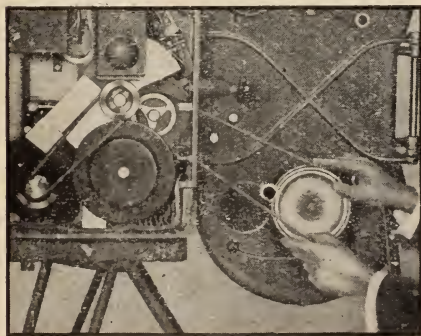


The equipment is attractively styled, and it can be easily erected within a few minutes. Two large milled screws secure the projector to the stand, and the twin spool box is fixed up in one manipulation.



Also mounted on the cam shaft is a small steel gear wheel which drives a large novotext gear wheel on the shaft of a 40-tooth sprocket. These are the only two gears in the mechanism.

Below you can see that the motor drives the cam shaft of the intermittent unit via a belt. A large flat shutter which is mounted on this shaft works at the same time as a fly-wheel for the intermittent unit.



NEW portable equipment gives a bigger, brighter picture

combining many extra safety features

BESIDES giving a brilliant picture measuring 13' 2" x 9' 10", Philips new portable 35 mm. equipment also combines many extra safety features. In fact, these features make danger from fire almost negligible.

Sound reproduction of both voice and music is exceptionally clear and true-to-life. Another advantage of the equipment is its light weight; this is because the projector casing is made of aluminium and the driving mechanism is greatly simplified.

Neither the projection lamp nor motor can operate if:—

- ★ the projector doors are open.
- ★ the film speed drops below 20 pict/sec.
- ★ the automatic film-rupture device comes into operation.
- ★ the pad rollers have not been closed.
- ★ the belts have not been put on.

Should the film catch fire in the gate, the twin spool-box fire trap automatically shuts. A ventilating rear shutter minimizes heat on the film.



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BRITISH KINEMATOGRAPHY

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APRIL, 1951

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THE TELEKINEMA

KINEMAS are not an uncommon feature in exhibitions. The weary and satiated visitor no doubt looks to the kinema, with its soft lights and padded seat, to provide a temporary haven from the excitements of the exhibition world without. Such an audience is not likely to be over-critical and would probably accept with gratitude a programme based on the conventional pattern of kinema entertainment. The question therefore facing those of us responsible for the Telekinema was whether we should depart from the accepted norm and seek to stimulate and excite our visitors with the unexplored potentialities of the medium.

The decision to venture on the experimental was made at an early stage in our planning, and both the programme production and architectural requirements were closely co-ordinated with each other. It was discovered that a considerable amount of research and experimentation with stereoscopy and stereophony had already been done by persons working independently of each other. One of the main tasks was to bring these people together and give a specific direction and form to their independent efforts.

The Telekinema, therefore, in addition to entertaining the visitor, should serve the equally important

function of providing those interested in the technical and creative aspects of film and television with an opportunity for exploring the techniques that may well influence the kinema of the future.

One of the virtues, perhaps, of an exhibition is that one is able to do things that would not in the language of the trade be termed commercial propositions. The experience gained, however, is of great value to the industry and will no doubt help engineers and film makers to find a practical solution to the problems attendant upon the introduction to the kinema of television and a third dimension in picture and sound. Already evidence has been received from commercial concerns in this country and the United States that some of these innovations may soon become commonplace in the commercial kinema. I have no doubt that the original research which has been done by the architect, engineer, scientist, film maker and technician, stimulated by the problems set by the Telekinema, will have contributed not only to the success of the exhibition and the Festival, but also to British prestige at home and abroad.

J. D. RALPH.

B.F.I. Films Officer, Festival of Britain.

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PLANNING THE FESTIVAL OF BRITAIN TELEKINEMA

Wells Coates, O.B.E., Ph.D., F.R.I.B.A.

Read to the B.K.S Theatre Division on October 8, 1950.

WHEN the Festival authorities laid down their programme for this building in August, 1949, no one was very sure about a name to describe a theatre for the projection of television and film material on to a picture screen. Somewhat haphazardly it came to be called the *Telecinema*. I asked for some suggestions, some ideas for a new name for a new kind of theatre, a place of entertainment and possibly, too, of instruction, which might in the future become a normal component of social life.

Within a matter of days, Mr. Ivor Brown, writing in the *Observer* under the heading "Fun and Names," said:—

The Festival of 1951 is to have in London on the South Bank a new building which will show both films and television. Such double-purpose halls are likely to become more numerous as television wins its way against its still jealous rivals. Mr. Wells Coates, the appointed architect, is at present thinking of "Telekinema." Will that attract? It frees us from the Greek and Latin muddle of *television*, which should be *teleoptics*, and gives us a wholly Hellenic collision, roughly meaning "far-movey." And, although Mr. Douglas Young, Scottish champion of the native tongue, puts Far-Speak instead of Telephone on his notepaper, it is doubtful whether the public would welcome the rustic-sounding Far-Movey on the Bankside.

I do not propose to inflict upon you all the curious combinations of words, the collisions of many kinds, which came to me via this paragraph: an all-time low was registered, I think, by one correspondent with "Videatorium." An irate novelist was against any architect messing about with the English language and claimed that "Cinema" was accepted usage, and so "Telecinema" quite proper and in no sense to be interfered with! The matter was referred to the highest authority—Mr. Gerald Barry, the Director-General of the Festival—and the final de-

cision was that Telekinema—that "wholly Hellenic collision"—was to be used for the fascia sign.

Functional Design

This mention of "collisions" is perhaps more apt than one may imagine as an introduction to this paper. The Festival Telekinema is indeed the result of a number of collisions, or should it be said that it is the moulding together of a number of seemingly colliding forces into a recognizable and significant form which, functionally, does its job, and, architecturally, reveals its function in a logical and, it is hoped, a pleasant way.

For myself, and for all the technicians who have enthusiastically assisted me in planning this building, the whole job has been considered as a kind of laboratory experiment. It is hoped that the experiment will succeed; if it fails, it will have been in a good spirit and a gay mood.

I propose to approach this subject by setting out, first, the general conditions which were placed before me by the Festival authority—the "operational requirements," so to speak, for the building. Secondly, I shall describe how these requirements were translated, in a geometric-planning sense, having regard also to the particular conditions of the site itself. Lastly, we shall describe the special equipment of the building in general terms; more specific information will be given to you by the experts of the firms most closely associated with the equipment.*

Requirements of Telekinema

The Festival Authority, in the person of Mr. Hugh Casson, Director of Architecture, set out in very broad terms the conditions for the Festival kinema:—

* To form the subject of papers in later issues of this journal.

1. *Size*.—This was conditioned entirely by the nature of the available site and the financial outlay allotted. Not less than 400 seats were to be provided. Minimal “offices,” no stage, no stage effects.

2. *Programmes*.—What constituted the most important factor in the broad statement of requirements was the provision, in a set programme of approximately one hour's duration, of both large screen television and film material. The original conditions suggested that *two* screens might be provided. Apart from a broad statement of safety considerations, very little further information was given: it was left to the architect and his associates to work out what *could* be pro-

vided. Mr. John Ralph, of the British Film Institute, attached to the Festival Office, was in charge of purely film and film-making arrangements, assisted by Mr. Raymond Spottiswoode. Above all, the main work of interpreting the requirements fell to the technicians of the three principal firms associated with the development of special equipment: the British Thomson-Houston Company, Cinema-Television, Limited, and Electrical and Musical Industries Limited.

3. *Category of Building*.—This important question was debated at the outset. The Festival Exhibition had largely been planned as a temporary affair, but with a theatre, requiring all the usual precautions for safety of the public, some revisions were necessary. In the event, the building has been planned

Site of Building

First, the site: it is located at the York Road end of the “downstream” section of the Exhibition, that portion which lies between Hungerford railway bridge and Waterloo Bridge. The site is hemmed in by the railway bridge, by the York Road ramped “roundabout” to Waterloo Bridge and by the remains of what used to be Howley Street.

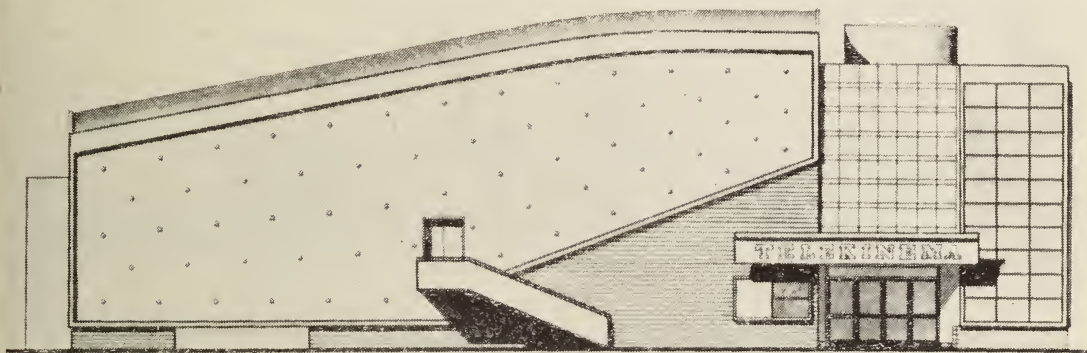


Fig. 1. Side Elevation of the Telekinema

Although this site was triangular in form its dimensions did not allow of a “fan-shaped” plan, nor did the financial budget run to the expense of such a structure with its unequal spans, etc. The first decision to be made, therefore, was to adopt, for so small a theatre, a parallel-sided plan, so that maximum economies of structure could be attained. The building was consequently located on a line parallel to Howley Street—which was the longest leg of the triangular site—with the access or entrance block nearest the railway bridge, the flank wall terminating on an angle parallel to it.

Sectional Geometry

If this building could be said to have anything new or novel about it, perhaps it is in

its sectional planning. Various considerations led me to adopt the section shown: these may be summarised as follows:—

1. The projection throw of the Cintel projector: about 40 to 45 feet was the maximum with existing equipment, or with any equipment which could be developed by 1951.
2. The adoption of 35 mm. safety stock, which released us from the normal regulations demanding special precautions against fire and explosion risks which so closely determine the sectional form of most kinemas, with the projection room at the top of the building.

“Lobster-claw” Section

Numerous geometries—as I call the early stages of planning—were tried and found wanting before it was possible to consider the problem quite freshly from first principles. I therefore started again, and quite simply set up the screen in section, marking off about 45 ft. and locating the television projector there, with zero angle of throw, and putting the two film projectors behind. It seemed obvious from previous investigation that about one-third of the seats would

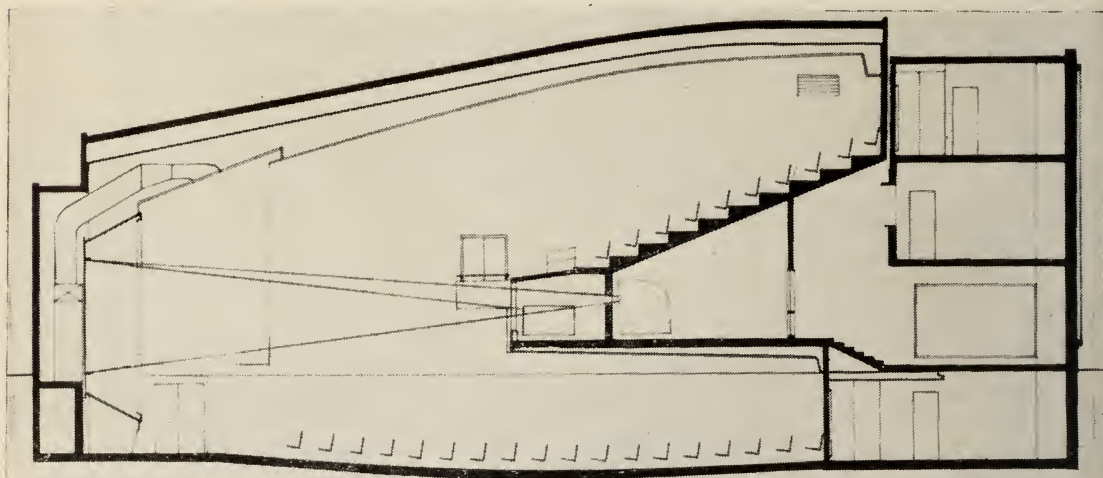


Fig. 2. Section through Centre Line of the Telekinema, showing position of the Stalls, the Balcony and the Projection Room.

3. The general form and dimensions of the site: the new ground level for the general exhibition terraces was to be some 10 feet above the existing “basement” level of the houses previously occupying the site; this made it economical to build a lower ground level without excavations.

It has always seemed to me that kinema design has too slavishly followed the principle: plan a theatre with stage, screen, stalls and circle seating, and then put the projection suite over, with a downward angle of projection of anything up to 18° or more. The adoption of such a sectional plan produced the familiar difficulty: how to locate the television projector, with its short throw, without cancelling a large number of seats and without interfering with film projection. It will be appreciated that the forced adoption of a parallel-sided plan increased this purely spacial difficulty.

have to be located on a balcony, so these were drawn in over the projectors, and a reversed ramped stalls floor completed this elementary diagram. This was the beginning of the really intricate business of fitting in everything to suit the diagram, and what may be termed a “lobster-claw” section was the result, the upper claw reaching to the back row of the circle seats, the lower claw to the back of the stalls, the projection room and its equipment being the tidy morsel tightly gripped in between.

A further feature became available to us at this stage: the back of the projection room faced the main entrance foyer and, as we were using safety stock, why not, it was asked, make a show of the projectors and associated equipment? A viewing window is therefore provided for the public as they pass through the foyer to stalls or circle seats.

The Festival Telekinema will, in fact, exhibit its "works" for all to see in a way not possible in normal kinema planning.

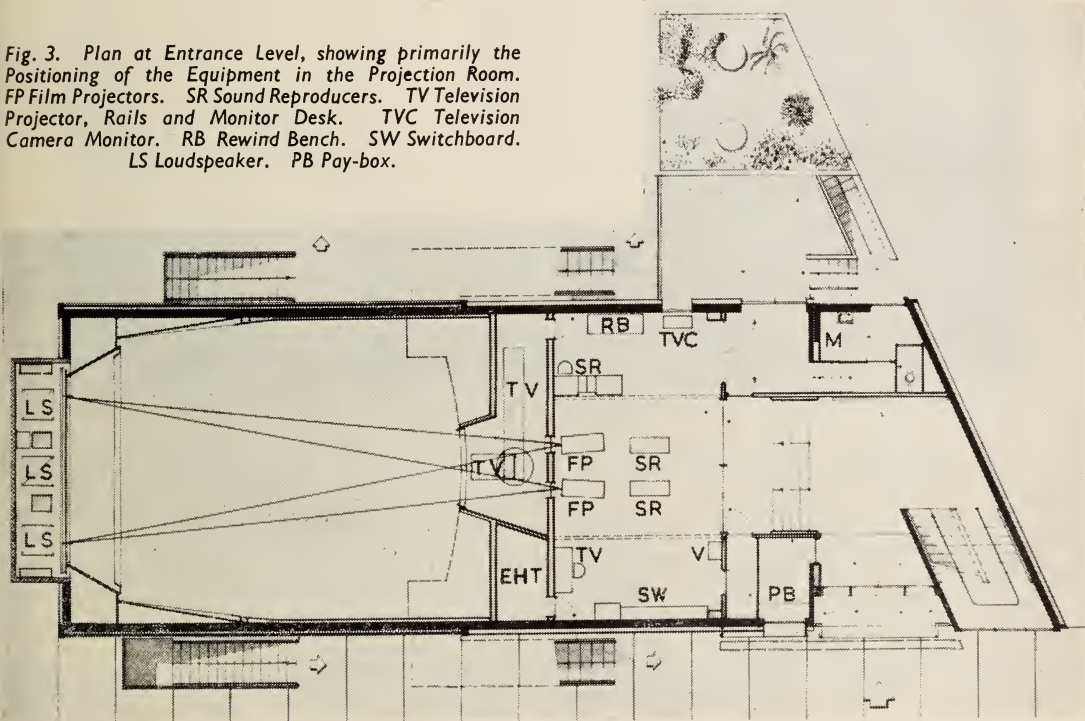
Planning the Equipment

The next stage—of detail planning—was now possible, and a further examination of dimensions, sight angles, sizes of equipment, weights, structural media and a host of other matters showed that even very slight alterations of dimensions in any one section made

for this concession—to arrange for the television projector to be housed on a sliding track, with turntable, so that the projector will move away into its adjacent "kennel" after its performance, and make way for film.

In detail, the plan at balcony level is, of course, cut into by this forward television projection area, but the number of seats lost is minimal, and on either side of the balcony front are located two little *loges* for important guests.

Fig. 3. Plan at Entrance Level, showing primarily the Positioning of the Equipment in the Projection Room. FP Film Projectors. SR Sound Reproducers. TV Television Projector, Rails and Monitor Desk. TVC Television Camera Monitor. RB Rewind Bench. SW Switchboard. LS Loudspeaker. PB Pay-box.



the plan unworkable. The detail planning of this building has employed every cubic inch of available space; structural elements and finishes have had to be very closely determined and defined.

Thus it was not possible to ensure, at the outset, that the television projector could remain in a stationary position, because we had to cater not only for two film projectors, but also for the projection of a "colour surround" or "borderless screen" effect as well. Thus it was decided—and I am grateful to the technical staff of Cinema-Television

Elements of Building

The illustration of the external elevation of the Telekinema shows how the section is expressed architecturally: the upper claw is revealed as one generic form, gripping the projection room with its outer walls faced with brickwork, and abutting the entrance or access block to the right; the lower claw of the section, extending to the back of the stalls, is, of course, below the "terrace" ground level.

The building naturally divided itself into the following elements, and a short descrip-



Fig. 4. Entrance Foyer to the Telekinema, showing the Viewing Window of the Projection Room.

tion of the types of structure employed, and the sound insulation used, may now be made:—

1. Access block containing main entrance, main staircase, usual "offices" and "cross-overs" to the stalls and circle seating, together with the viewing platform facing the back of the projection room.
2. Main theatre, containing two subsidiary components:—
 - (a) Balcony steppings, projection room and suspended floor over the back rows of the stalls.
 - (b) The screen chamber, containing also intake ventilation equipment, at the far end of the theatre; this forms a separate structure, projecting from the end of the main theatre block.

Main Structure

These elements of the Telekinema are constructed in the following manner:—

The main structure is of reinforced concrete 10 ins. thick, forming the "tanking" to ground level—to deal with flood levels on this site—and carried up to the roof line on side walls, together with certain flank walls

acting as wind bracings. This part of the structure is roofed with prefabricated bow-string units made entirely of dovetail steel sheet units of standard dimensions: 34 ft. span, 3 ft. height at centre of chord, 2 ft. in width, anchored to the 10-in. reinforced concrete walls, and carrying a suspended ceiling internally.

The access block is similarly constructed of reinforced concrete, without beams or columns, and is structurally disconnected from the main theatre by a 1-inch insulational gap; thus this element of the building, located closest to the railway bridge, is able to vibrate independently without transmitting sound to the main structure.

The balcony steppings, together with the projection room floor, carrying a suspended ceiling over the back row of stalls, are constructed of a skeletal framework of structural steel; a portion of the main girders is revealed inside the projection room. These elements are enclosed by prefabricated dovetail steel sheet units; this method allowed a

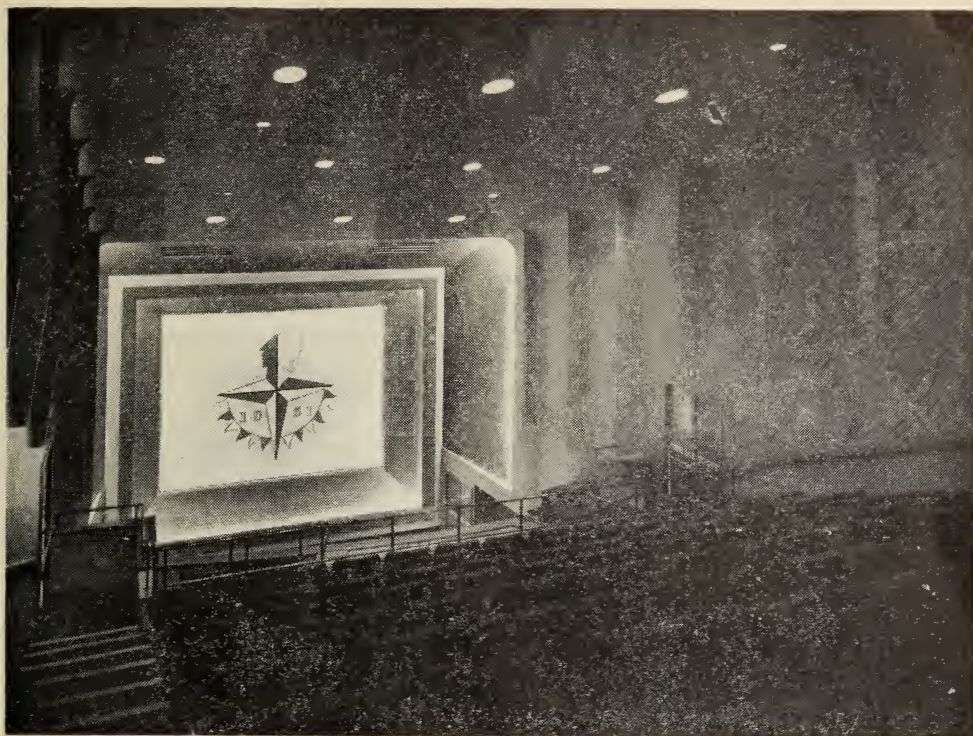


Fig. 5. General View of the Auditorium, taken from the Balcony, showing the Proscenium and the Lighting.

certain amount of detailed development of the proposed technical equipment to proceed without interfering with the time and progress schedule for reinforced concrete work, which was very rapidly constructed and provided with suitable anchorages for the remaining elements of structure. This decision was a fortunate one, for it was possible by altering gauges of sheet steel to increase the stiffness of the elements to take increased loads for equipment, as the latter increased in dimensions and in number of elements, while building was actually in progress.

Methods of Prefabrication

It may be said that this type of structure is not ideally suited to the problem, but it should be appreciated that the schedule of requirements for equipment was constantly being added to, and weights, dimensions, installational wiring, etc., increased month by month. We were faced with the problem of proceeding with building at the same time as increasing the building requirements, thus a

flexible method of construction was essential.

The architect has developed, through this experience, methods of prefabricating elements of structure in kinemas, particularly those elements which are most closely associated with equipment and with equipment installations. Analyses based on these forms of construction have shown that substantial economies can be effected provided, of course, all elements of equipment are known factors, and for theatres of this kind these elements may now be said to be known most precisely.

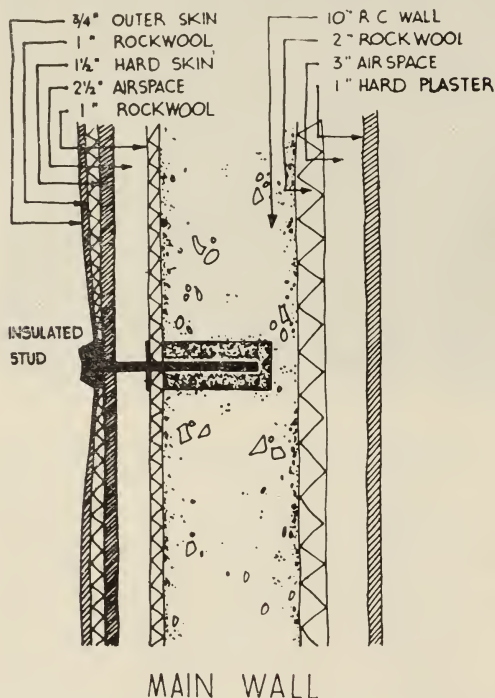
The screen chamber enclosure was also designed for dovetail sheet steel construction off site, to be brought to the building and located there after most of the other main constructional work had been completed. As the main theatre has only four side openings (the exit doors), the open end was most useful for the introduction, for instance, of main steel components for the balcony and projection room area, and of other building components. The screen chamber was the

last component of structure to be completed.

An annexe block was subsequently added, to provide toilet and dressing-room accommodation for the ever-increasing staff requirements of the Telekinema. This projects into the garden area at the York Road side of the building, and is constructed of reinforced concrete with simple finishings.

Cross-section of Building

The main structural elements had to be clothed in various forms of insulational and



insulational diagram of the roof itself. Below this membrane, hangers with an insulational break of rubber are slung to support the suspended ceiling of metal lathing and plaster, or of perforated fibrous plaster with 2 ins. or 4 ins. of rockwool for those areas, adjacent to the screen, where sound-absorbing wall linings are required.

Sound Isolation

The main flank walls of the theatre section are constructed, as was noted before, of

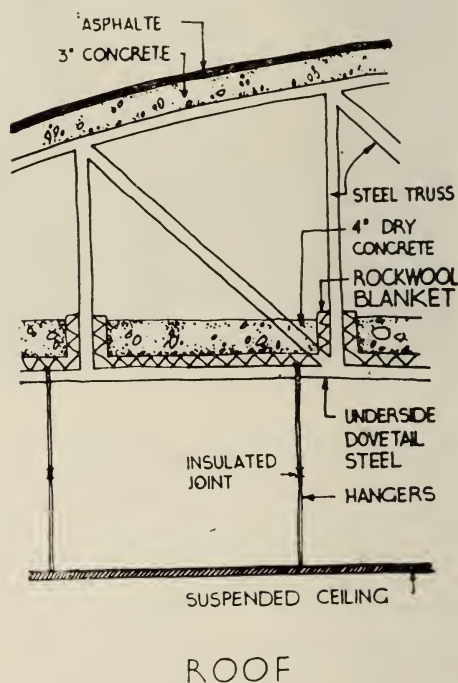


Fig. 6. Diagram showing the Construction of the Wall and the Roof.

"finishing" techniques; the diagrams showing these (Fig. 6) may be described as follows:—

The main roof, constructed as already described, has a 3-inch concrete cover plus asphalt roofing, with a pure aluminium "trim" or flashing. On the topside of the lower layer of sheeting of these bowstring units, rockwool blankets are laid loose, and these are weighted down with dry concrete of 4-inch depth; this latter mass is, therefore, not in direct contact with any structural steel and forms the final chain in the

10-inch reinforced concrete. This panel, which reveals externally the upper section of the "lobster-claw" form, is faced with a "quilt" constructed of the following layers or membranes:—

1. Light rendering for finish, on expanded metal, with a "quilted" indentation at the point of support of each of the studs described later.
2. 1 inch of rockwool covered both sides with bituminous paper.
3. 1 1/2 ins. cement render on metal lathing hung on a series of studs which are anchored in insulated rubber mountings in the 10-in.

reinforced concrete wall.

4. $2\frac{1}{2}$ ins. air space.
5. 1 in. rockwool blanket adjacent to external face of concrete wall.
6. Main wall: solid 10 ins. reinforced concrete.
7. 2 ins. rockwool on inner face of the concrete.
8. 4 ins. airspace.
9. Insulated brackets supporting expanded metal inner acoustic wall of solid plaster, or of perforated fibrous plaster, as required for internal acoustic correction.

Thus the wall insulation is composed of a series of membranes, the outer one being in the form of a "quilt" which vibrates on its own externally, together with a solid mass of

ing, as will be seen from the illustration, is a development in mathematical terms of the regulated proportions of the external elevation.

The screen chamber component, constructed of double membrane dovetail sheet steel units, is rendered externally with cement and sand, the inter-space filled with dry sand, and the inner membrane sprayed with gunned asbestos to form a sound absorbing internal face around the loud speakers and ventilating ducts.

The access block flank wall facing the bridge is of solid r.c. 9 ins, thick. Externally

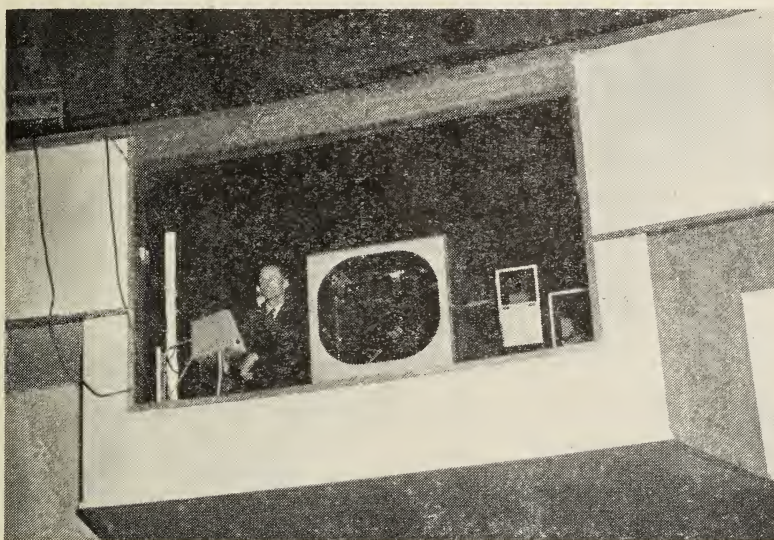


Fig. 7. The position of the Cintel apparatus when in use.

concrete insulated both sides with rockwool, plus the internal skin as described. The sequence of layers from inside to outside is hard, air, soft, hard, soft, air, hard, soft, hard. These are calculated to break down and absorb both high and low frequencies to the desired reduction of from 85 to 30 phon. Special arrangements are made for external doors; these are of Holoplast plastic double skin slabs, filled with sand, and with an internal air space. The edges and trims are faced with perforated Holoplast filled with glass silk. The doors for the balcony exits weigh 500 lbs. per leaf.

The pattern of studs externally is revealed as an architectural feature, and their plac-

there is an airspace, and a final layer of 3 ins. slabs of Gypklith rendered externally for final painting. Other walls of this component are similarly treated.

Special Equipment

We may now pass to a description, in general terms, of the special equipment in the Telekinema (see Fig. 3).

The Cintel projector¹ moves out of its "kennel" into the central projection position, at approximately zero angle of throw relative to the screen, giving a 16 ft. x 12 ft. picture.

Opposite the television projector "kennel" is the E.H.T. room, and here Cinema-Tele-

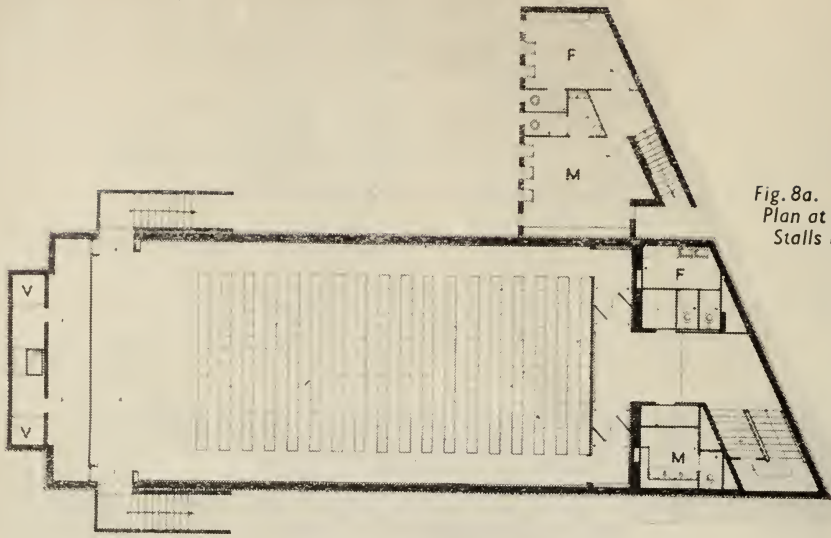


Fig. 8a.
Plan at
Stalls Level.

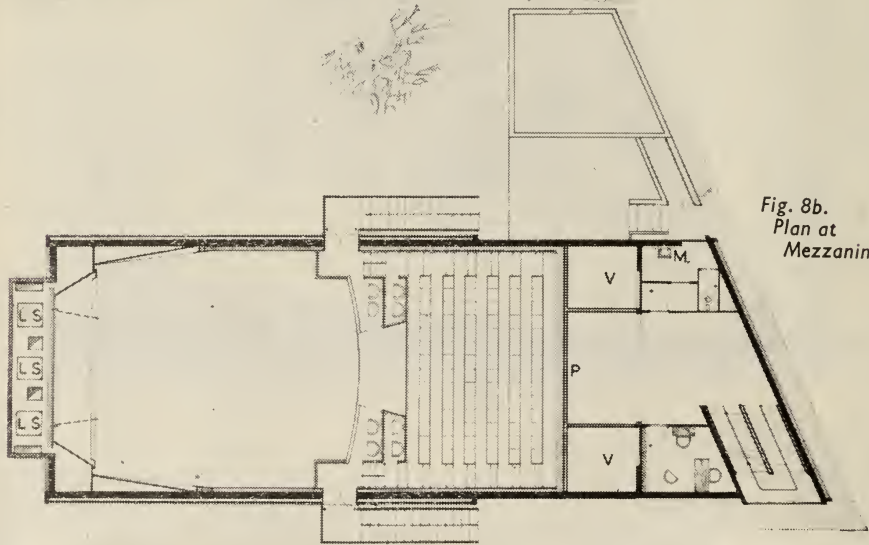


Fig. 8b.
Plan at
Mezzanine Level.



Fig. 8c.
Plan at
Balcony Level.

vision have devised entirely new equipment to produce, through power packs and R.F. units, the requisite voltage of 50,000 volts for the projector. In the forward projection area is located the "remote controller" for picture correction by an operator in full view of the screen.

Inside the main projection suite, and to the left of the film projectors, is located the Cintel console with its monitor tube, monitor speakers, etc., receiving television material and passing it through to the projector. To the left of this unit is located the main switchboard, and the Westinghouse 3-phase rectifier² for the British Thomson-Houston projection units.

Centrally to left and right are the two B.T.H. SUPA equipments,^{3,4} and immediately behind these the two sound reproducers developed by B.T.H. and E.M.I. in collaboration, to produce four channels for the stereophonic or "panoramic sound" effects. The SUPA equipments embody their new devices for projecting the "colour surround." The remainder of the B.T.H. equipment comprises Selsyn generator and contactor units, located under the lower landing of access block stairs to stalls level, in an insulated room. Associated with this is a Selsyn selector box, located on the wall to the left of the left hand projector in main projection suite.⁴

Speaker Assemblies

The loud speaker assemblies are controlled through a loud-speaker selector box located to the right of the right hand projector in main projection suite, and comprise:—

- (a) At screen end, three loud-speaker assemblies for stereophonic effects.
- (b) 2 loud-speakers in main ceiling.
- (c) 4 loud-speakers under projection room, serving back stalls.
- (d) 2 speakers on back wall of circle seats.
- (e) 4 speakers on back wall of stalls seats.

There will be some 24 separate speakers in the theatre, including monitor speakers in the projection suite.

To the right of the projection suite are located two sound reproducers by E.M.I., one for "binaural" interlude music and the other for monaural music as a standby unit.

In this area is also located the Rigby rewind bench⁵ and film-drum store, with special equipment for rewinding synchronously the left and right eye films required for the stereoscopic films.⁶

Television Cameras

Lastly, the television camera unit, with Marconi equipment, including camera on a special dolly, monitoring and control units, are located as mobile units. It was necessary to have our own television camera unit inside the building to ensure some television material for each of the hourly programmes. The main foyer and the projection suite will be used as a studio for live interviews: these areas have consequently been provided with special lighting. These pictures will be piped direct to the Cintel control console and thence to the projector; it will be possible to take pictures, through the projection ports, of the television projector "projecting itself."

When suitable outside broadcasting material is available from the Festival Exhibition site, or from the B.B.C. broadcasts, this will be channelled into the programme.

Auditorium Lighting

The main lighting of the theatre is split up as follows:—

- (a) Main ceiling: primary and secondary "maintained" lighting and oval spot-lighting for general illumination.
- (b) Stalls aisles: a continuous lighting strip (incandescent).
- (c) Ante-proscenium: cold cathode continuous strip lighting by G.E.C.
- (d) Screen picture frame: cold cathode continuous strip lighting by G.E.C.

All lighting is controlled through the G.E.C. dimmer⁷ located in a room in access block, and specially developed for this building.

The screen itself has been specially developed by Mr. J. L. Stableford and is stretched on a light metal frame behind the picture frame, which, unlike the normal proscenium arch, runs in a splayed shape all round the screen. This frame is constructed of fibrous plaster with steel supports; the perforations allow sound to escape to the rockwool insulation behind.

In lieu of a curtain, a special form of venetian blind is to be used, on which the Festival of Britain symbol will be revealed. The blind and its control gear have been developed by Messrs. Avery.

Ventilation

A simple system of blown and filtered intake air from screen end is employed, the foul air being extracted at the other end of the theatre through ducts leading to two extract chambers located left and right at the back of the projection room-balcony section. This equipment has been made and in-

stalled by Engineering Service Installations, who were also responsible for all electrical and plumbing and sanitary installations in the Telekinema.

loges to left and right of the television projection booth are loose tub chairs designed by Geoffrey Dunn. Thus the full seating capacity is 402 seats.

The carpets, by Firth & Sons, cover the whole of the stalls and circle areas and aisles to either side ; the whole of the access block floors and staircases are also carpeted.

Above the viewing window to the projection suite is a large mural painting by John Armstrong depicting film sets and scenes. The general scheme of decoration internally has been kept to the simplest forms and elements, blues and greys predominating,



Fig. 9. The Mural Painting above the rear window of the Projection Room.

with polished mahogany hardwood trims, bronze ballusters and railings. The aim has been to concentrate upon the picture screen and not upon extraneous "decorative" effects.

Decorations and Furnishing

The series of fins on side walls of the main theatre are slightly deflected towards the screen, and act as diffusers and absorbers of sound.

A special form of seating, devised from part-standardised elements, designed by the architect and made by Messrs. A. Cox & Co., is being used. The fabric coverings by Morton Sundour are designed by Mrs. Lucienne Day. There are 252 seats at stalls level, 18 rows of 14 seats each, at 3 ft. row spacing, 1 ft. 8 ins. seat spacing ; 10 rows of 14 seats are located at circle level, adding a further 140 seats. The ten seats in the

Programmes

The programme material intended for the Telekinema will follow this sequence: 10 minutes of television, in the form of live interviews and topical events ; interlude music from the E.M.I. special reproducers ; two or

Programmes

three special Festival films of a documentary nature, followed by two or more specially developed stereoscopic films with stereophonic sound effects. The stereophonic sound system will also be used to provide a special "sound only" programme ending with the National Anthem. The whole programme will last about 80 minutes.

Spectacles of the polarised type will be handed out during one of the interludes and collected at the end of the performance.

Conclusion

I trust that I have given you an overall picture of the problems involved in planning

the Festival of Britain Telekinema, which have given me and my associates a lively time, and brought forward solutions which may form in some sense a precedent for future planning of small theatres of this kind. During the course of the developments of the plans for this theatre we have encountered many new problems and endeavoured to solve them in a straightforward and logical manner. We have also devised systems of structure and requirements for new types of equipment for the kinema of the future out of the experience and knowledge gained in planning, building and equipping this experimental laboratory, the Telekinema.

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7. *G.E.C. Jnl.*, Oct., 1950, p. 159.

DISCUSSION

Mr. R. H. CRICKS: Dr. Wells Coates has modestly under-estimated the acoustic problems of the site—that a few yards away is a railway bridge carrying five lines. If five trains were to pass simultaneously, does he consider that the noise would be inaudible in the auditorium?

THE AUTHOR: The problem of sound insulation in that part of the site is very difficult. It was looked into very carefully by the Building Research Station in regard to the permanent building, the L.C.C. concert hall, where requirements are far fiercer than those normally required in a kinema. They have solved the problem there by a full double wall construction. In planning the little theatre, we have endeavoured to meet the conditions to the best of our ability. We are using, for instance, sound insulated doors. We hope to have a sound reduction through the main side wall of the theatre and through the roof of something of the order of 40 to 45 units, bringing us down inside the theatre to a level of between 30 and 35 phons. I devised the system myself, and submitted it to the Building Research Station, who thought it would do the job reasonably well. The fiercest condition is the low frequency level, which is quite fundamental on the site. If five trains were going through at the same time, one would hear a low groan.

Mr. H. LAMBERT: In the plan of the projection suite I noticed there is no provision made for a rewind room. Is rewinding going to be done in the projection room?

THE AUTHOR: Yes, we decided not to have a separate rewind room, because we wanted to show the whole of the area to the public. There will be a rewind bench in one of the corners, and also storage for the film being projected.

Mr. R. H. CRICKS: Is this exemption from legal requirements to be made general in the case of

theatres running non-flam film?

THE AUTHOR: The Festival authorities are absolved from the provisions of the London Building Act, but they have their own safety precautions department. I decided it was not possible to conform to the sound insulation problems, and produce a merely temporary building with one-hour fire risk. I decided it would have to be built more solidly, and it was, in fact, an economy to do so. The extra mass of the walls is of great value in the reduction of sounds.

A VISITOR: Having this large window at the back of the box, there will be a fair amount of light in the projection room.

THE AUTHOR: The projection room will be visible to the public only before the start of the show. We hope by suitable adjustment of the general lighting to prevent reflections into the television booth during television projection.

Mr. J. L. STABLEFORD: Is there any special reason for the screen surround to be at an angle of 45°?

THE AUTHOR: My feeling was that I wanted to get rid of the old stage proscenium type of surround, and I therefore put a frame right round the picture. The frame closer to the screen is in the same material as the screen itself; the curtains come in front of that, and then a further picture frame, providing an acoustic absorption area, will carry cove lighting to illuminate the curtains.

A VISITOR: What provision is being made to prevent the intensive interference from the electric trains in such close proximity to the television equipment?

THE AUTHOR: I imagine that Cinema-Television are dealing with this problem. We are not taking television material from an aerial in the area, it is a "piped" transmission. I am assured there is no difficulty.

BUSINESS RADIO IN FILM PRODUCTION

Howard M. Layton, Assoc. Brit. I.R.E.*

IN recent years the film industry has made use of various types of radio-telephone apparatus to assist in the communication requirements of film production. The "Walkie-Talkie" type of equipment, famous for its war-time applications, has proved very useful on widely dispersed film location sites, and for co-ordinating "actions" in which large numbers of artistes have been involved.

More recently, the rather longer range mobile equipment known as "Business Radio" has received some attention, and since communications with this latter may be quite reliable over distances of the order of 20 or 30 miles, its scope within the industry is worthy of investigation.

Indeed, one Business Radio installation has already been used as a means of passing instructions between a Studio Production Office and its Location Unit operating in various parts of London.

It is intended, therefore, that the present paper should be regarded as a general introduction to Business Radio technique so far as it may concern the film industry.

Reasons for V.H.F.

Radio-telephony in business is licensed for operation on spot frequencies in the 70-100 Mc/s and 156-184 Mc/s bands. Frequencies of the order of 460 Mc/s and higher are also available, but as far as the writer is aware, mobile equipment suitable for these latter frequencies has not yet been marketed. All of these frequencies may be classified as V.H.F., and in order to gain a full appreciation of the scope and limitations of available apparatus, a brief examination of some of the more important propagation characteristics of V.H.F.'s will perhaps be helpful.

Long distance radio communication relies on the properties of those layers above the earth's atmosphere which form the ionosphere. When a wave-front meets this

ionised region, refraction or "bending" takes place, and at medium carrier frequencies this bending is usually sufficient to turn the wave back towards the earth again.

By further reflection from the earth's surface, a number of such "hops" is possible (Fig. 1), and in this way a signal may cover several thousands of miles before it is finally dissipated. The phenomenon known as ionospheric propagation is responsible for virtually all long range radio communication.

At frequencies in excess of about 10 Mc/s, however, the angle at which a wave front is incident at the ionosphere determines the degree of refraction to which it is subjected, and for any particular frequency f , there is a critical value θ of this angle, at which refraction becomes insufficient to turn the wave back to earth. At angles of incidence greater than θ , the wave, therefore, penetrates the ionospheric layers, and is lost in outer space.

As f is increased, the critical angle θ decreases, until at frequencies between 50 and 60 Mc/s, the effects of ionospheric propagation become small, and for the purposes of this discussion may be neglected altogether.

Avoidance of Interference

Neglecting tropospheric effects, radio communication above about 60 Mc/s is therefore restricted to the direct ray track, which seldom penetrates far beyond the transmitting aerial's horizon. This horizon, interpreted for ground-to-ground communication over flat country, would lead to an expectation of range of the order of 20 to 35 miles, according to aerial height. Thus, in contrast with the ranges of hundreds of miles which are obtainable at medium frequencies, it is customary to think of V.H.F. ranges in terms of only tens of miles.

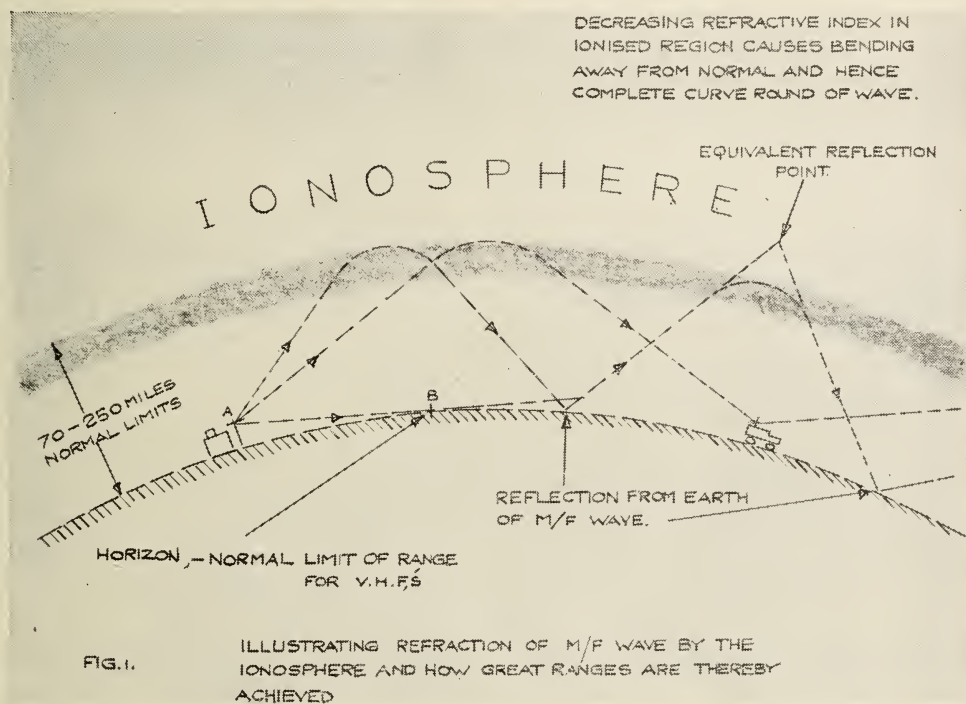
As the number of mobile radio systems in operation is already large and is increasing almost daily, it would not be difficult to

* Alfred Imhof, Limited (Radio Telephone Div.).

imagine what would happen if the long range frequency bands were used. The allocation of different spot frequencies for each user would be quite out of the question, since the most generous allocation of "space" in the frequency spectrum would only accommodate a fraction of the numbers involved. Excessive mutual interference between services in widely separated areas would therefore be inevitable, and as a result the usefulness of this form of communication would be severely restricted.

countered *en route*, it is possible to assess its chances of reaching any particular distant receiver.

Assuming that the fixed station aerial has been erected on the roof of a block of offices, or, for that matter, on a film studio roof, all that can be seen on a perfectly clear day from this position, the signal may be expected to reach. Further, since the earth's curvature tends to curve the path of the signal too, the visible horizon may usually be extended by about 20% when interpreting V.H.F.



The use of very high frequencies automatically suggests itself, for with these, interference problems are much more localised, and by judicious allocation of spot frequencies and intelligent aerial siting, most such problems become soluble. The need for V.H.F.'s will now be clear.

Results in Built-up Areas

Having established that for business radio purposes the transmitted signal must follow a substantially direct path, and that its fate will therefore depend on earthly objects en-

range. As the height of this roof-top aerial is increased, the horizon begins to recede, and range is increased accordingly until a limit is reached at which the wave is finally dissipated in the myriad of nature's ever-absorbing elements.

In general, buildings in the immediate vicinity of the mobile receiving aerial need not be regarded as serious obstacles because they reflect and scatter incident waves in much the same way as wet surfaces reflect and scatter light. Thus, the mobile counterpart of the studio installation, moving be-

tween tall buildings which shield it completely from the fixed station, will normally receive signals without difficulty.

Naturally, a signal reflected from the wall of a building must suffer some degree of attenuation, and for this reason very thickly built-up areas are not always negotiated without some difficulty.

This is especially true when such areas are situated near the natural horizon of the fixed station aerial, for in these circumstances the wave front arrives at a very low angle, and may have to force its way through a considerable "depth" of man-made obstructions before reaching the mobile unit. Sporadic fading and the occurrence of

Where the headquarters of a business radio installation is situated in low country or in a valley, the range restrictions which it would normally suffer can be overcome through the use of a very high aerial mast, or by what is known as "remote control." The latter, which is by far the more practical and cheaper expedient, may be explained as follows:—

A neighbouring hill (up to 10 or even 15 miles away), which from a business radio standpoint would normally be regarded as a liability, is turned to good use as a location for the fixed station aerial. It is usually possible to find some building on such a hill where an attic or cupboard may be rented

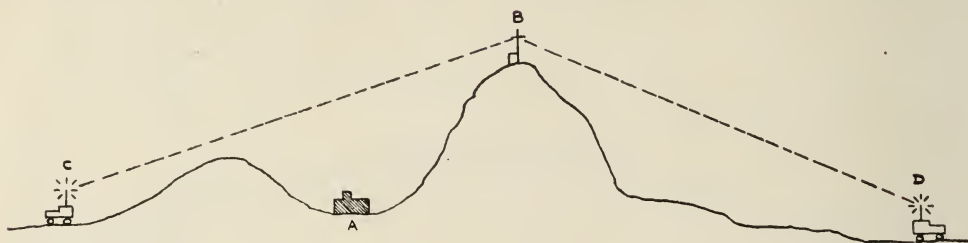


FIG. 2.
THE CONTROLLING OFFICE AT 'A' IS BADLY SITUATED FOR V.H.F. COMMUNICATION PURPOSES THE ACTUAL STATION AND AERIAL MAST ARE THEREFORE SITED AT 'B', AND CONTROLLED FROM 'A' OVER G.P. TELEPHONE LINES
THIS DRAWING, ALTHOUGH EXAGGERATED, WILL SERVE TO ILLUSTRATE THE VALUE OF REMOTE CONTROL TECHNIQUE

"blind spots" are effects which are thereby commonly experienced.

Remote Control

Large obstacles, such as hills, are by no means readily negotiated, and communication is likely to be completely curtailed when a hill interrupts the direct path between transmitting and receiving aerials. Indeed, if the fixed station is located in a valley, completely encircled by ground higher than the aerial mast, communication will in general be restricted to that valley. Clearly then, aerial height is one of the most important single factors in determining the range that a given installation will provide,

for the master set. The aerial, carried on a pole of moderate height, is then erected on the roof or chimney of these premises, and the complete station is linked with the distant control point over a pair of Post Office lines. Needless to say, the equipment is left untended and need be visited only at rare intervals for inspection and maintenance purposes. If the hill is 300 ft. higher than the surrounding country, and the aerial is 50 ft. above ground (20 ft. pole on a house chimney), a total height of 350 ft. is achieved.

The prospect of erecting a mast of comparable effective height on low ground would be unthinkable for most ordinary installations, yet the considerable advantages

afforded by such a lofty site can be enjoyed with remote control at very little capital outlay.

Installation in London Area

The Imhof installation at Hampstead Heath is an excellent example of the remote control technique. The fixed station is located in a small room at an inn on the top of the Heath and its aerial (100 ft. pole) stands behind the building.

Telephone lines are used to link the equipment with the controlling office at New Oxford Street, and at this latter address a Radio and Television Service Manager uses the system to control his fleet of service vehicles. The average radius of coverage achieved is of the order of 35 to 40 miles, and in many directions is well in excess of this figure.

Contrast this with the average range of 15 miles afforded by the previous local installation at New Oxford Street itself. This latter made use of a 60 ft. mast erected on the company's building, which is about 100 ft. high. Ground level at New Oxford Street is about 100 ft. above sea level, so that the local aerial was 250 ft. above sea level. Ground level at the inn is 440 ft. above sea level, so that the existing 100 ft. mast provides an aerial height of 540 ft. above sea level. The wide discrepancy in the results obtained with the two aerials is therefore not surprising.

Single or Dual Frequency

Single frequency working, that is to say, a system in which transmitter and receiver use the same frequency, does not in general appear to be popular with the licensing authorities. This method of operation permits of direct communication between one mobile unit and another and thus robs the master station operator of the power to discipline the use of the channel. If an organisation operating a fleet of, say, 20 vehicles used this system, and the drivers of half the vehicles attempted to hold conversation with the other half at the same time, the resulting mutual interference would be likely to render the received signals quite unintelligible. In

such circumstances, the "master" station would be powerless to justify its title.

Dual frequency working, which is orderly in its nature, is almost universally employed. All mobile units transmit at a frequency X and receive at a frequency Y , whilst the fixed station uses these frequencies in reverse. Thus a transmission from any one mobile will be received only by the master receiver, and if a number of mobiles call at the same time, all can be instructed to stand by for permission to pass their messages in turn. Communication between vehicles is then achieved only by relaying messages through the master station. It follows, therefore, that in a dual frequency system only one transmission can take place at a time. Each such transmission is originated or received by the master operator, who is aware of the nature of all communications and is in a position to control and record them.

A further important fact in favour of dual frequency operation is that with this system it is possible to repeat frequencies in areas which lie much closer together than would be possible in single frequency schemes. In consequence, more licences can be issued for any given area.

Simplex and Duplex Working

Duplex operation, which does away with the need for a transmit-receive key, enables the equipment to be used exactly as if it were an ordinary wired telephone. Used in conjunction with vehicles, however, duplex working presents certain problems. The transmitter and receiver require separate aerials, and as it is difficult to provide adequate spacing for these, a need for specially designed R.F. systems arises and introduces complications where they are most unwelcome. Furthermore, as both transmitter and receiver are operating together, demands on the battery supply tend to be heavy.

For the above reasons duplex operation, where required, is normally confined to the fixed station, and for mobile work the simplex technique is more popular. A send-receive key mutes the receiver whilst the transmitter is in use and also operates a relay which switches a single aerial as required.

Systems of Modulation

Voice frequencies from the microphone may be impressed on the radiated carrier wave in one of two principal ways.

Amplitude modulation and frequency modulation, as they are known, both have their ardent supporters in the field of application now being discussed. Until quite recently F.M. was widely regarded as being capable of much higher fidelity standards than A.M. and also of being immune from nearly all forms of interference. The former supposition has now been discredited, however, and it is generally accepted that, given equal sideband limits, A.M. and F.M. are able to account for themselves equally well.

It is true that because the majority of man-made static interference exhibits A.M. characteristics, a frequency-modulated receiver tends to be freer from certain types of noise than its A.M. counterpart. At frequencies of the order of 180 Mc/s the difference is not appreciable, however, and in practice few can say with certainty which technique is being used when judging the performance of representative equipments. As F.M. technique tends to complicate design and to be rather critical of adjustment, it is not as widely used as is often supposed.

In this country amplitude modulation prevails, and its choice, by the Post Office authorities for use in conjunction with the Thames River Service will serve to illustrate its continued popularity. The proportion of A.M. to F.M. in use at present for business radio installations is likely to be about 4 to 1.

General Design

Through the use of semi-miniature techniques and careful design, manufacturers have succeeded in keeping the size and weight of their equipment within convenient limits. The mobile transmitter, receiver and power unit may be contained in one or sometimes two robust cases, designed for fitting either in the corner of the boot of a car or in any other convenient position in a commercial vehicle. Shock absorbent mountings ensure that vibration is not excessive, and quick release devices enable sets to be removed speedily for servicing and replacement. The

actual control panel with small built-in loud speaker is mounted near the driving position, and is connected with the main equipment by a multicore cable. Some models designed for mounting under the dash-board of a vehicle are completely self-contained, but these, whilst compact, have certain disadvantages. Leg room in a vehicle is seldom generous, and the space occupied by sets of the dash-mounting type is often greater than can be readily spared. Furthermore, the mechanical hum from the rotary transformer is added to the general background noise level.

The aerial system is almost invariably of the Marconi quarter-wave type, and takes the form of a short "stick" mounted on the roof of the vehicle. The metal work of the vehicle roof forms part of the aerial system and is essential to it. Where the roofing material is non-metallic, an artificial ground plane is normally fitted, and may take the form of a metal plate or strips of metal suitably arranged.

The power output of the mobile transmitter is limited by the battery drain permissible, and does not usually exceed about 15 watts; 5 watts is a representative figure, and the Pye P.T.C. 113 is rated for this output. On the whole, increases of power output do not bring about improvements in performance to the extent that might be expected, and the results obtained with aerial powers of the order of 1 watt and even less have been remarkably encouraging.

The fixed equipments use somewhat larger outputs than their mobile counterparts, and although the most popular level is about 15 watts, outputs of 25, 50 and 100 watts are used. Fixed receivers, although basically similar to the mobiles, usually include refinements which would be considered rather ambitious for ordinary mobile work.

A Particular Range of Equipment

The Pye P.T.C. 704 fixed station, and P.T.C. 113 Mobile Station, are representative of apparatus currently available, and a brief description of the general design of these equipments now follows.

The Fixed Station Receiver is a crystal controlled double superheterodyne, of sensitivity such that for a signal input of 1 micro-volt (modulated 30% at 400 c/s), an output of 50 milliwatts is delivered to the built-in loudspeaker. The R.F. arrangement is as follows (Fig. 3):—

The input signal of frequency f_o is fed from the aerial circuit via the R.F. amplifier V1 to the grid circuit of the first mixer V3. A voltage from the crystal oscillator is multiplied through V4 and V2 and is also injected

oscillator voltage at $16X$ Mc/s for V3. Thus for spot frequency reception at 172.9 Mc/s the crystal frequency will be

$$\frac{172.9 - 2.9}{17} = 10 \text{ Mc/s}$$

and the oscillator frequency for V3 will be $16X = 160$ Mc/s. This frequency beating with f_o will produce a first I.F. of 12.9 Mc/s, which itself will beat with the crystal fundamental in V5 and provide a second I.F. of $12.9 - 10 = 2.9$ Mc/s.

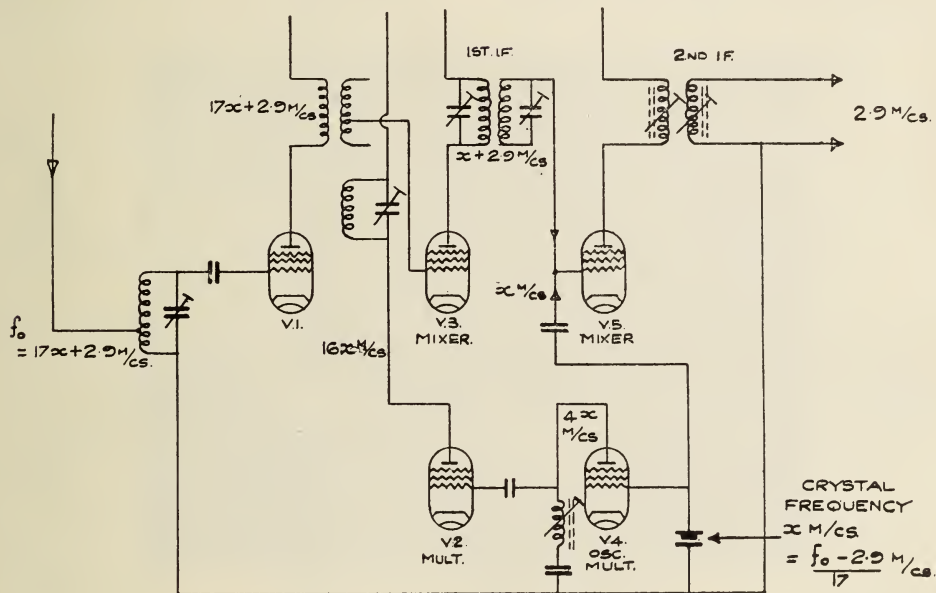


FIG. 3. SKELETON CIRCUIT SHOWING BASIS OF DOUBLE SUPERHET ARRANGEMENT IN PYE PTC 704 RECEIVER FOR 180 Mc/s BAND.

into the grid circuit of V3. The difference frequency or 1st I.F. is such that when fed to the second mixer V5, it beats with the crystal fundamental frequency X (also fed to V5), and produces a second I.F. of 2.9 Mc/s. Interpreting this procedure for frequencies within the high band (156-184 Mc/s), the required crystal frequency is found from the formula

$$X = \frac{f_o - 2.9 \text{ Mc/s}}{17}$$

and the circuits of V4 and V2 multiply this frequency four times each to provide an

For low band operation (70-100 Mc/s) the multiplication factor is reduced by half, and calculation of the crystal frequency is modified accordingly.

The second I.F. chain consists of two valves and eight tuned circuits in the form of four over-coupled band-pass transformers. A series-shunt diode noise limiter is operated by the audio signal from the demodulator valve, and this has the effect of suppressing impulsive noise of the type due to car ignition systems.

An audio output of 2 watts maximum provided by the 6V6 GT output valve is fed to

the built-in loudspeaker and a proportion of this is also available for the 600 ohm line output circuit.

Muting Circuit

The valve V7, which provides A.V.C. for valves V1, V3, V5 and V6, also works in conjunction with V9 and V11 which constitute the carrier operated muting circuit (Fig. 4). The latter functions as follows:—

A D.C. voltage proportional to the incoming signal plus noise is smoothed and applied as a negative voltage to the grid of the D.C. amplifier V9. This causes an am-

noise plus signal at the grid of V9. The magnitude of this positive voltage can be adjusted to give resultant negative voltage at the grid of V9, which is proportional to signal alone. By this means RL1 is made to operate by an incoming carrier only, and is unaffected by variations in noise level, provided that the noise is fairly evenly distributed within the receiver pass band.

Fixed Station Transmitter

The design of this part of the equipment follows standard A.M. practice and incor-

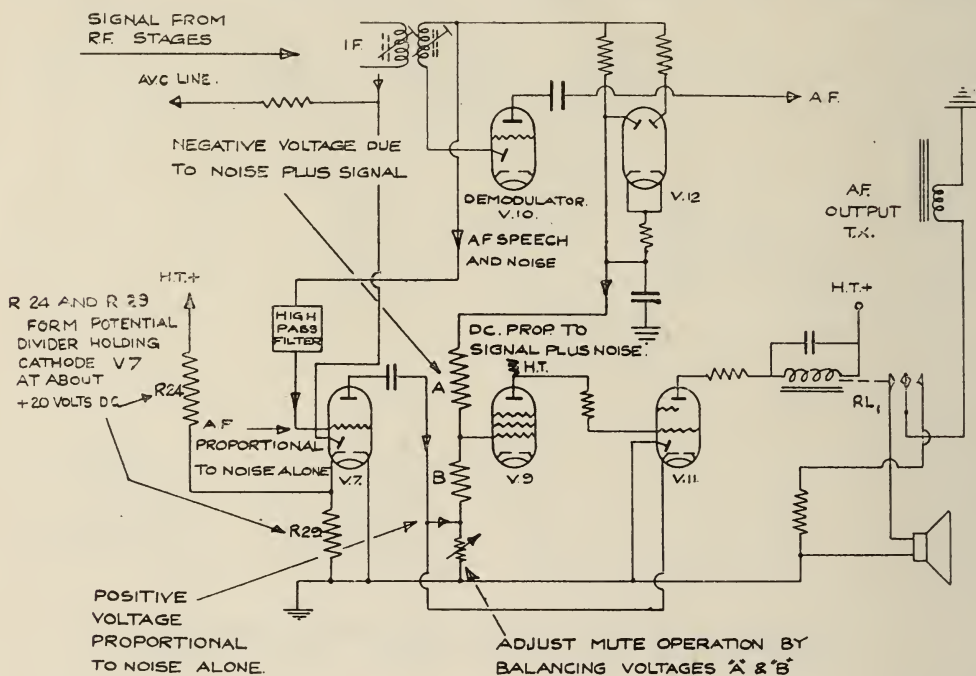


FIG. 4

CARRIER OPERATED MUTING CIRCUIT
(SKELETON)

plified positive voltage to be applied to the grid of V11, thus increasing the anode current of V11 and tending to operate the relay RL1 which connects the receiver output to the loudspeaker. A.F. voltage from the demodulator diode is fed to the grid of the A.F. amplifier V7 via a high pass filter. The filter removes all components of speech frequency, leaving an A.F. signal which is approximately proportional to noise alone, and is added to the negative voltage due to

porates a crystal oscillator to whose anode circuit is tuned (in the case of the 156-184 Mc/s) to the third harmonic of the crystal frequency. Two doubler circuits follow to provide a voltage at 12 times the crystal frequency for driving the grids of the double tetrode power amplifier (832).

The transmitter modulation amplifier comprises a first voltage amplifier followed by a pair of phase-splitting valves which in turn feed the grids of the two beam tetrode power

amplifier valves (6V6 GT's). Connection to the amplifier input transformer may be from a 15 ohm moving coil microphone or from a 600 ohm line, whilst the output transformer secondary is connected in series with the anode and screen supply to the 832 P.A. valve.

The transmitter provides a carrier output of 10 to 12 watts, modulated to 100% on peaks, and uses a coaxial feeder (nominal 75 ohm impedance) to carry this output to its dipole aerial.

hand-microphone carries the transmit button which controls the H.T. supply to the transmitter, and is connected to the control box by means of an extending cable whose cover is of spiral moulded rubber. Coaxial cable of nominal impedance 30 ohms is used for connecting a piano-wire type of quarter-wave aerial with the main equipment.

A Practical Case

During the making of the film "Pool of London," Ealing Studios, Ltd., decided to

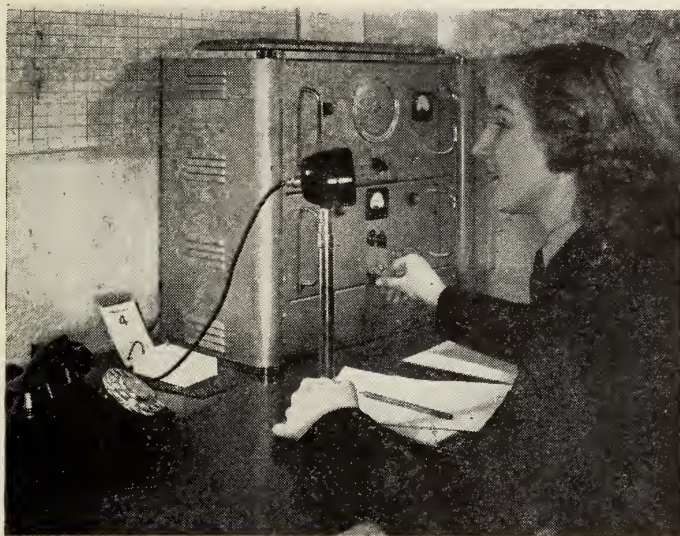


Fig. 5. The Pye PTC 704 equipment in use.

Pye P.T.C. 113 Mobile Equipment

Electrically, the mobile sets are of similar general design to the fixed equipment, except that they use smaller types of valves and components and derive their H.T. supplies from a compact rotary transformer. This latter operates from a 6 or 12 volt battery supply according to the user's specification. The complete equipment is contained in a steel case measuring $14\frac{1}{2}$ ins. \times $7\frac{1}{2}$ ins. \times 9 ins., and is intended for mounting in the boot of a car.

The operator's control box measures 7 ins. \times $4\frac{1}{2}$ ins. \times $2\frac{1}{2}$ ins. and carries the on-off switch/volume control, and a built-in loud-speaker. It is usually mounted within easy reach of the driving position. The small

make use of radio-telephony on their location work, and experiments which preceded this decision provide interesting material for discussion here.

Initially, it was required that the studio production office should be able to communicate with a vehicle operating in the vicinity of Tower Bridge, and although this amounted to no more than about 12 miles of range, the project was not without its problems. First, the terrain at Ealing is on average only about 50 ft. above sea level, and secondly, the signal had to traverse a vast built-up area in which many thousands of buildings would tend to impede and dissipate the transmitted carrier wave.

For first experiments an aerial mast was

erected on the studio water tower to afford the dipole a height above ground of about 98 ft. The master station was then installed in the studio manager's office, and trials over the territory between Ealing and Tower Bridge showed clearly that the aerial mast employed was not sufficiently high to "see" the car at London Bridge over the intervening metropolis. Setting off from the studio, reliable communication was maintained only

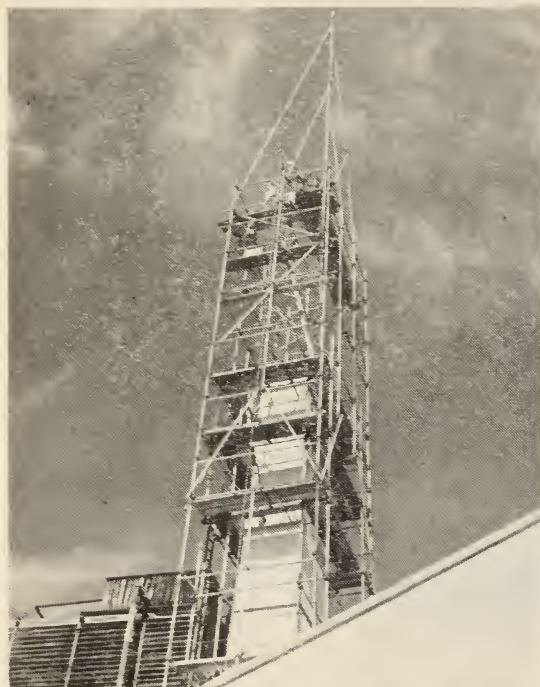


Fig. 6. Temporary Ultra Short Wave Aerial at Ealing Studios, used for Radio Telephone Communication with Location Units. (Note: The Scaffolding Structure was already around the Chimney for repair work, and was extended to give additional height to the aerial, which is at the extreme top).

as far as Westminster, and at Waterloo Bridge signals were only just readable. It will be interesting here to relate that during one test, the studio car was stationary on the west side of Waterloo Bridge itself, and it was noticed that whenever a bus passed by on the far side, signals at the car receiver came up to full strength. The steel sides of the buses were naturally presenting a large reflecting surface to the wave front, and when the car and bus were abreast the signal at the

receiving aerial was, of course, considerably augmented.

Tests were continued a few days later with the studio aerial mast 25 ft. higher. The route between the studio and Tower Bridge was covered again and on this occasion a good signal was maintained all the way, with the exception of certain local "blind spots." This improvement resulting from such a limited increase of aerial height aroused the enthusiasm of the studio construction team, who decided immediately that their mast was not quite as high as it could be. A few days later the dipole aerial had been raised a further 22 ft. (145 ft. above ground) and the fixed station had been moved to a new position near the foot of the mast. A remote control unit was installed in the studio manager's office and linked to the main equipment with suitable cable.

Subsequent reports established that the Tower Bridge area was now safely within operational range.

Aerial Improvements

The studio team responsible for the efficient operation of the scheme then took steps to guard against any possibility of "blind" spots interfering with the success of their project. Remembering the tests on Waterloo Bridge and the effects experienced when buses were passing, attention was directed to the improvement of the receiving aerial system. A sleeve dipole similar to that used for the fixed station was bolted to a small telescopic pole and this latter was bolted in turn to the rear of the vehicle bodywork. With the pole in the collapsed position the dipole was just clear of the vehicle roof and remained thus for travelling purposes. When stationary in what would normally be a "blind" spot, however, the pole could be extended up to 25 ft. and in general communication would be re-established. Surveys in many quarters showed clearly that for this particular application the telescopic aerial had decided advantages, and ranges up to 40 miles were recorded. Throughout the location work on the film referred to, the radio telephone was used extensively, and according to reports by the production staff, the

equipment saved its cost in a matter of weeks.

For one particular sequence it became necessary to pass "shooting" directions between a shore position and a barge on the river. For this work the master station was moved from the studio and taken to the shore location, and the mobile equipment was removed from the car and installed on the barge. Aerials were placed in any convenient ground position, and since the distance to be covered amounted only to yards, they might well have been dispensed with altogether.

It is clear from the above notes that the standard equipment used could find many applications within the industry, and, indeed, its success in the case described might well lead to its eventual adoption as an everyday location requirement.

It occurs to the writer that if the film industry as a whole were allocated a common working frequency, then equipments owned by one studio could be hired to another as location requirements fluctuated. Such a suggestion leads to the idea of a pool of radio telephone apparatus available for circulation among the studios according to principles which govern the economic deployment of other types of technical gear.

The writer is indebted to Mr. Baynham Henri, F.B.K.S., of Ealing Studios, Ltd., for his co-operation and permission to publish the surveys described in the latter section of this paper. The kind assistance of Mr. H. Bottle, of Pye Telecommunications, is also gratefully acknowledged in connection with the checking of the technical accuracy of the text.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

MOTION PICTURE INSTRUCTION IN COLLEGES AND UNIVERSITIES

J. Morrison, *J. Soc. Mot. Pic. & Tel. Eng.*, Sept., 1950, p. 265.

In United States educational institutions 300 courses are provided in various aspects of motion pictures, as compared with 86 only in 1946. Less than half-a-dozen of these offer a comprehensive course in motion picture production.

R. H. C.

THE HIGH SPEED PHOTOGRAPHY OF UNDERWATER EXPLOSIONS

P. M. Fye, *J. Soc. Mot. Pic. & Tel. Eng.*, Oct., 1950, p. 414.

Reference is made briefly to the photographic techniques. The method for explosions of charges weighing up to one pound at depths down to two miles is described.

A. H. A.

VARIABLE POWER LENSES: THE "PAN CINOR" LENS

R. Curillier, *Bull.A.F.I.T.E.C.*, No. 8, 1950, p. 3.

The optical construction of well known variable power lenses is discussed. The "Pan Cinor" lens which has been designed for 16 mm. film is described.

A. H. A.

NOISE OF CAMERA MOTORS

K. O. Frielinghaus and Hoffman, *Bild und Ton*, Nov., 1950, p. 334.

A study of the noise produced by camera motors shows that mechanical noises are due chiefly to lack of rigidity of various elements, unbalance of the rotor, or play in the bearings. Principal noises of electromagnetic origin are at 100 and 300 c/s, caused by magnetisation and demagnetisation; such noises can be decreased only by use of a larger motor.

R. H. C.

NEW "ALL-DIRECTION" BABY CAMERA DOLLY

Lee Garmes, *Amer. Cine.*, Sept., 1950, p. 307.

The wheels of a camera dolly may steer either in normal fashion, or may be set to give sideways movement. The dolly is only 32 ins. wide, and provides a camera height of from 15 ins. to 52 ins. from the floor.

R. H. C.

NEW THREE-COLOUR METER FOR EVALUATING ILLUMINANT QUALITY

Lars Moën, *Amer. Cine.*, Sept., 1950, p. 310.

The "Spectra" colour-temperature meter has been modified to provide separate readings of the three spectral components. Readings are expressed in terms of the blue-red ratio and green-red ratio.

R. H. C.

THE COUNCIL

Summary of meeting held on Wednesday, March 7, 1951, at 117 Piccadilly, W.1

Present : Mr. L. Knopp (*Vice-President*) in the Chair, and Messrs. W. M. Harcourt (*Past-President*), E. Oram (*Deputy Vice-President*), H. S. Hind (*Hon. Treasurer*), T. W. Howard, B. Honri, N. Leever, R. E. Pulman, S. A. Stevens, and R. J. T. Brown (*representing Papers Sub-Committee*).

In Attendance : Miss J. Poynton (*Secretary*).

COMMITTEE REPORTS

Library Committee.—The deterioration of the library books likely to occur if they are indefinitely contained in the present fixtures has led to a recommendation being submitted for approval:

"That the industrial shelving should be replaced by dust-proof bookcases."—*Report received and adopted.*

Theatre Division.—In the 1951/52 session, special consideration is to be given to the meetings which have an appeal for the projectionist. The meetings will take place on Sunday mornings and the first will be of such a character that any projectionist present will be able to help in the choice of subject matter for the remainder of the papers in the session.

The Society has been invited to become the examiner in the Apprenticeship Scheme to be organised in conjunction with N.A.T.K.E. and the

Ministry of Labour. Plans are being made accordingly.—*Report received and adopted.*


Film Production Division.—Arrangements for the visit to the B.B.C. Television Studios, Lime Grove, on Saturday, May 19, are going forward. The studios will be in operation, and a discussion meeting will conclude the visit. Applications for tickets should be made without delay.—*Report received and adopted.*

Education Committee.—The courses on "Lighting for Kinematography" and "Sensitometry," which commenced on February 26, are full to capacity.

Appreciation is recorded for the work carried out by the Vice-President, Messrs. B. Honri and R. J. T. Brown in connection with the courses.—*Report received and adopted.*

Trainee C.M.A. Managers.—The students training to become C.M.A. Managers will be kept in touch with the programme of papers for the 1951/52 session, and invitations will be extended to them to attend meetings whenever they wish.

B.S.I. Jubilee Exhibition.—The arrangement of the Kinematograph Exhibit at the Jubilee Exhibition, "Fifty Years of Industrial Standardisation" will be carried out under the ægis of the Society. The following *ad hoc* Committee has been appointed to deal with the matter: Messrs.



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The Convention.—The following *ad hoc* Committee has been appointed to make the necessary arrangements for the Convention: Messrs. E. ORAM (*Chairman*), B. HONRI, N. LEEVERS and S. A. STEVENS.

"Better Business" Campaign.—5,000 copies of the reprint of the paper read by Messrs. R. E. Pulman and S. B. Swingler entitled "Motion Picture Presentation" are being distributed by the Film Industry Planning Committee.

Gift to the Society.—The Society is indebted to Mr. Hillyard T. Stott for the gift of:

(a) A 35 mm. projector, less lantern but with lenses. An interesting specimen of the lesser-known loop drive system, popular between the era of the claw mechanism and the Maltese cross.

(b) About 6,000 ft. 35 mm. positive film, including "Topical Budget," C. 1916, showing the first captured German submarine brought ashore at Harwich or Felixstowe in the 1914-18 War, and including shots of the stars of those days.

The Proceedings then terminated.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

A. CHALLINOR is in charge of the Home and Export Film Studio Equipment at G. B. Kalee, and not the complete section, as was implied in the January issue.

T. S. LYNDON-HAYNES is now Production Manager for Romulus Films, Ltd.

D. V. MOTTURE was the optical printer operator in the new Italian film "Il Miracolo a Milano," which has just been awarded the Grand Prix at the Cannes International Film Festival.

PERSONAL ANNOUNCEMENT

Situation urgently required by Camera Operator experienced in documentary and feature production, highest references and Press reviews, has own Newman Sinclair camera if required. Box No. 99, British Kinematograph Society, 117, Piccadilly, W.1.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than situations Vacant, not accepted.

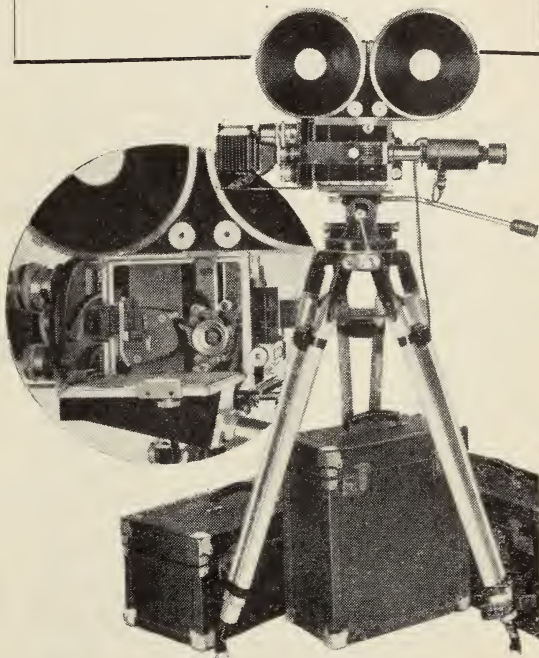
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BRITISH KINEMATOGRAPHY

VOLUME 18, No. 5

MAY, 1951

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TECHNIQUE AND SHOWMANSHIP

IN the face of lay publicity of a sensational character it may seem heresy to comment that Telekinema's justifiable claims to novelty are strictly limited. Nevertheless, the bringing together of a number of items previously demonstrated individually has a social significance for our members. We in the B.K.S. are particularly concerned that the efforts and achievements of the technical side of the industry shall not be misrepresented or mishandled before the eyes of the world. That is why we are especially interested in the Festival of Britain Telekinema, which might be regarded as the shop window of future developments.

Here were to be demonstrated stereoscopic and stereophonic films in colour, large screen television and the latest technique our industry has to offer, under conditions which were to be, presumably, the standards for the future. If, in the Telekinema, this objective has been obtained, then the outlook in our industry is indeed bleak. However, reconsideration convinces one that the acute sense of disappointment arises more from the matter presented than its manner of presentation.

At the Telekinema, films seemed more closely linked with the eclectic dilettantism of the British Film Institute than the bold showmanship of the Barnum School or the Joe Vegoda Birthday Drive.

Further, the bad showmanship, both in type of film selected and in the manner of their presentation, is in no way related to the best this country has to offer. Many members have commented on such blunders as the seating arrangements. There appears to be no attempt to stagger seating to give clear vision past the row in front, and occupants of rear stalls find the upper part of the screen cut off by the balcony soffit. The occupants of front stalls, on the other hand, get an excellent view if they adopt a neck-tiring posture reminiscent of the dentist's chair.

Ceiling lights are featured to such an extent that they prove an annoying distraction within the field of view during the performance.

It would be unfair to criticise the sound quality at so early a stage, since the shortcomings of the first demonstration will no doubt be dealt with quickly and effectively. It does seem apparent,

however, that the sound engineers have been given a very difficult problem to solve in producing a stereophonic effect from a relatively narrow proscenium. The use of speakers in the ceilings of stalls and gallery seems to have a stunt value only, but is capable of providing weird effects. The technical performance of both B.T.H. SUPA Projectors and Cintel large screen television was, of course, well-nigh perfect.

Finally, the films shown do not seem to provide anything approaching the spectacular demonstration which should be possible with the equipment. The best stereoscopic demonstration took as its subject a voyage down the Thames—virtually a remake of Hepworth's "Stereo-scenic" of 1908. Other stereoscopic films were more modernistic (but less effective) than Hepworth's "Rescued by Rover," 1903—which, of course, would have made a splendid subject for stereoscopy. In the ordinary course of events, film criticism is not perhaps a field in which many B.K.S. members would care to express opinions publicly, but here is a case of the poor choice of subject matter being liable to give the world a wrong impression as regards both our film producing capabilities and our technical equipment. The experimental "arty-crafty" type of film will often, we hope, find a place in our film programmes as one of our more interesting variations of film diet, but we shudder to think of it as a staple food.

A critical review is of course, a very personal affair and to do any lasting good it must be candid. If we do not point out the mistakes ourselves, our foreign visitors will assume we are either disinterested or incompetent, and will themselves provide the criticism in no uncertain terms, or worse still, will "give polite praise and buy nothing." The fact that the demonstration may be aimed at the least informed public will not temper the blast.

Many of the shortcomings of the Telekinema may only be teasing troubles, other can be put right by determined and prompt action. It is hoped, for the benefit of an industry which is already hard hit in other directions, that action will be taken.

BAYNHAM HONRI,

Chairman, Film Production Division.

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Editor: R. HOWARD CRICKS, F.B.K.S., F.R.P.S.

Hon. Consulting Editor: GEOFFREY PARR, M.I.E.E. F.B.K.S.

THE TELEKINEMA—PERSONAL IMPRESSIONS

By courtesy of the British Film Institute and the authorities of the South Bank Exhibition, members of the British Kinematograph Society visited the Telekinema on April 30, 1951.

As we emerge from beneath the railway arch, the unmistakable shape of the Telekinema is visible on our right. My two guests are visitors from abroad—men of some eminence in film production—and I feel called upon to adopt the traditional attitude of the Englishman on these occasions:

"Should be interesting," I comment, my outward nonchalance barely concealing my inner confidence that we are about to witness a performance which would symbolise the very highest achievements of British cinematography and television.

In due course, we are allowed to enter the building and are shown into seats near the back of the balcony. Here we find ourselves looking down a funnel shaped auditorium, which in shape and decoration somehow reminds me of the escalator shaft in Waterloo Underground station nearby, the rows of seats sloping away steeply beneath our feet like the steps of a moving staircase. The screen, covered by an unusual venetian blind, is set back in a light-coloured sloping frame which occupies the whole proscenium. The general effect is one of exaggerated perspective.

A curious "plonking" sound falls on our ears, a sound of indeterminate origin and timbre. My mind "flashes back" to wartime afloat, and the unforgettable sound of the ASDIC pings in the earphones. I consider, and as quickly reject, the idea that this may be some new form of amplifier test. I later learn that it is a demonstration of synthetic music.

The Third Dimension

We are provided with transparent visors, and as the venetian blind rises we read a title inviting us to put on our glasses.

A voice somewhere to my right ruminates on the progress of the last quarter-century: on how we used to view black-and-white three-dimensional films through coloured spectacles, while to-day we watch coloured pictures through "Polaroid" spectacles—

but apparently we still need the spectacles!

In the meantime, an abstract cartoon is busily engaged in presenting spots before our eyes in three dimensions, new spots being added in tempo with the soundtrack until every square inch (or should I say cubic inch?) of space is occupied.

A new title appears and it seems that we are to have a short talk on the third dimension. Our interest quickens. The picture is in monochrome, which is curiously restful after the colour cartoon. A man enters a room, walks over to us and begins to speak. At this point I begin to suspect that the sound is many frames out of sync. I hurriedly remove my visor, polish it, and take another look, but the three-dimensional picture and the three-dimensional sound continue to disagree on the fourth dimension, that of time!

I look timidly at my two companions. Their faces are grim behind their gleaming visors.

The artist, we find, is a comedian, a very diffident comedian, and he naturally brings us smiles rather than any intelligent exploitation of the medium in which he is portrayed. A few brief exterior shots are cut into his act and by their excellent quality serve to give some slight indication of what could have been done with a more imaginative script.

Another abstract colour cartoon follows, and takes as its theme the convolutions of the Lissajous figures familiar to users of cathode ray oscilloscopes. These are shown in depth, and some of the visual effects obtained are beautiful and at times spectacular, as when a slowly moving luminous ring is poised in mid-auditorium like the grin of Alice's Cheshire cat. For some two minutes I am entranced by these pretty patterns, for they are presented with great technical skill. Unfortunately, the film goes on for much longer than this. The images go round in circles—the film does likewise.

I try to detect any stereophonic effect in the peculiar vocal and orchestral accompaniment and fail entirely. I eventually attribute

this to the funnel-like shape of the auditorium and my position near the back. I am, in effect, sitting in the mouth of a vast horn, and all sound appears to come from the throat of the horn, that is, from behind the screen.

Technicolor on the Thames

The next film takes us on a river journey along the upper reaches of the Thames. This also is in colour, and incidentally shows up the reflective properties of the screen surround to good effect. The picture is obviously taken during the winter months when the deserted river hardly presents its most attractive appearance.

A few of the scenes stand out vividly, and serve to emphasise the undistinguished character of the remainder. I find that considerable effort is required to watch the picture in depth, and the use of the straight cut as a means of changing scene seems to impart a visual shock, as the eyes need a period of grace, however short, to readjust their focus. I have become aware of a headache.

The film stops (it does not seem to "end"), the lights go up and we wait expectantly. The curious plonking noises recommence, accompanied by the sound of escaping steam.

THE TELEVISION PROGRAMME

AS one enters the Telekinema past the window in the projection room, one observes the Marconi television camera amid the projection equipment, and the specially installed lighting shining into the foyer. Inside the auditorium, incoming patrons in the foyer are being televised on the screen.

The lights dim, and on the screen appears a reproduction of the foyer of the theatre. On the occasion of the Society's visit, Miss Joan Griffiths was seen interviewing Miss Petula Clark, but since the opening the interviews have been conducted by various B.B.C. commentators. There follows a survey of the projection room and its equipment.

To the layman, the effect is no different from that of a film. The picture is well lit—although to a rather lower standard than that of the film picture—and is free from the

I am feeling rather depressed when an usherette approaches. She is the most beautiful usherette in the world—definitely three-dimensional! As she asks for my glasses, I watch intently, then sigh with relief: her lips and voice are in perfect sync., and, what is more, as she passes on down the gangway I find my eyes can keep her trim figure in focus without any strain whatever!

Projection Equipment

On the way out, I show my guests the impressive installation of fine equipment in the operating box, thinking meanwhile of the way in which the opportunity of demonstrating it to the world was being squandered. Where were the spectacular scenes of land, sea, and air, which really need three-dimensional presentation? Where were the scenes of national character to interest overseas visitors?

My guests are sympathetic. They say that dilettantism can easily get out of hand, and that it can happen anywhere. That anyway it will amuse the public!

I point out that the night is still young and ask what they would like to do.

"Let's go to the pictures," they say, and we go off to enjoy ourselves.

N. LEEVERS.

shadowing which so often mars the television image. A better indication of the standard of reproduction is, however, gained during maintenance periods, when the B.B.C. test chart is shown: this is well focused and quite free from geometrical distortion.

The picture might indeed just as well be a film. The commentator makes a point of emphasising that we are watching television, since there is nothing in the material which serves to differentiate the presentation from a film. While to the technician it makes little difference whether signals are transmitted over a few yards or over many miles, to the layman a transmission from the foyer to the screen is hardly television.

Notwithstanding these criticisms, it must be put on record that the public reaction has been one of enthusiastic acclamation.

R. H. CRICKS.

SOUND FILM EQUIPMENT IN THE FESTIVAL OF BRITAIN TELEKINEMA

A. Bowen,* J Moir* and H. Turner*

THE Telekinema for the Festival of Britain¹ was planned to demonstrate to the public the most up-to-date techniques in the motion picture and television field, and it was considered a legitimate opportunity to obtain public reaction to advanced ideas that have interested the technician for some time without finding adequate public expression.

Though this paper is concerned with the sound film equipment, large screen television equipment² and the associated camera chain are also installed, and specially recorded interval music is reproduced by equipment provided by other organisations.

Early discussion with the Festival Office followed by preliminary demonstrations in our laboratories resulted in agreement to provide the following features:

1. Projection of ordinary "flat" black-and-white and colour sound films.
2. Replacement of the standard black screen border by an illuminated surround projected from the picture mechanism, the intensity and colour of the surround being related to the average picture content.
3. A stereoscopic picture using polarised light.
4. A stereophonic sound system with additional "front of screen" sound effects.

Production of the special films required for stereo picture and sound was arranged by the Festival Office.

I. STANDARD SOUND FILM

Two standard SUPA 35 mm. film projectors³ (Fig. 1) are installed for projection of normal sound films, the modifications necessary for the projection of the Halochrome border, stereo picture film and other special features being added to the basic machine.

The only modification required when projecting black-and-white sound film was the addition of a neutral light absorbing filter in front of the projector to reduce the light intensity on the screen. Messrs. Stableford

Screens, Ltd., having installed a special directional screen of high gain for the benefit of the television projector, it became necessary to reduce the screen luminance to tolerable values when showing film. This filter and the Polaroid filter required for the stereo picture are mounted in a disc mounted in a special housing bolted to the front of the projector, selection being made by rotating the disc to the required position.

2. HALOCHROME BORDER

Some pre-war investigations in the B.T.H. Research Laboratories in Rugby clearly demonstrated the disadvantage of the black masking border, the present standard practice of the industry. The war interfered with the commercial application of the alternative proposals, but the ideas were pursued for the Telekinema installation.

The black border is a relic of the early days of the kinema industry when screen illumination was low and picture edges rather ragged, but it has become so much a part of a standard kinema picture presentation that its presence is hardly questioned. That lusty newcomer television, having a similar problem in masking off the picture tube, tried the kinema industry's solution, but abandoned it after a few months, in favour of a light-coloured surround.

Visual acuity is at its maximum when the detail to be appreciated presents the maximum contrast to the background, but the presence of a black border ensures that the maximum contrasts occur at the edges, thus reducing the sensitivity of the eye to the detail in the picture.

In addition to the loss of definition, the darker tones, especially of colour films, in the picture are degraded by presenting them in comparison with the real blackness of the masking.

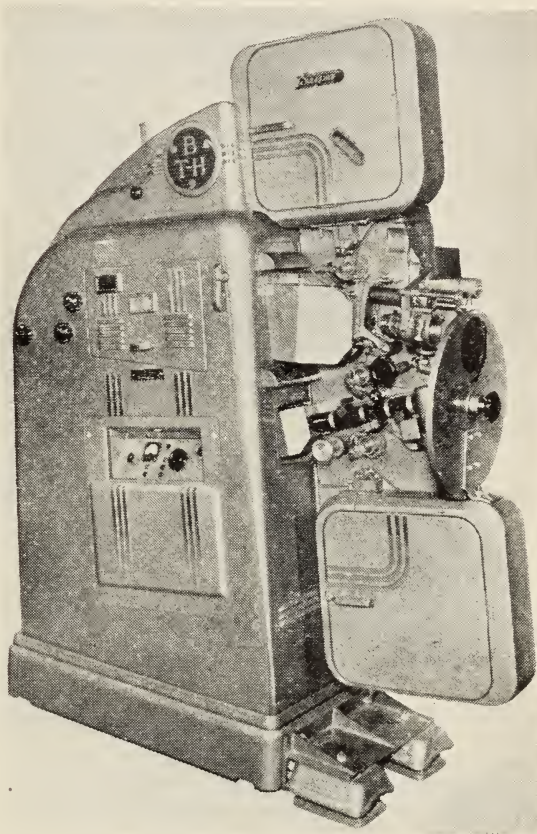
* British Thomson-Houston Co., Ltd.

Optimum Presentation

The requirement for optimum presentation of the picture detail and colour is clearly that it should be presented against a neutral background such that the highlights are always brighter and the dark shadows blacker than the surround. These conditions are satisfied by projecting the surround lighting from the film projector in such a manner that the surround intensity and

beam and slightly above it. After passing through a heat filter the light is directed by a condenser lens on to a full frame size aperture in the position normally occupied by the framing aperture, and passing through the film is modulated in intensity and assumes the colour of the picture. The colour content of the transmitted light is then defocused or diffused to give a uniform colour, masked to present the desired shape

Fig. 1. Standard SUPA Projector modified for the Telekinema. The Optical System for the projected picture surround appears above the Standard Optical System. The disc carries the Polaroid and Neutral Filters. Anti-vibration mountings have been added to the feet as the machines are mounted immediately above the audience.



colour is the average intensity and colour of the picture at all times.

In the new equipment this is achieved fairly simply (see Fig 2), by making use of the light normally wasted during the pull-down period when the shutter is closed. The standard shutter is replaced by a special shutter with reflecting rear surface to direct the light normally wasted, upwards to a second mirror which reflects the light forward in a beam approximately parallel to the picture

and projected by a corrected lens system which focuses the mask on the screen.

All the requirements of a perfect background are thus secured in a surprisingly simple manner; the average intensity and colour of the surround can be related in any desired ratio to the picture and is automatically maintained without any manual control.

It cannot be emphasized too strongly that the purpose of a projected surround is not to compete with the picture for the patrons'

attention, but to present the picture itself in the most attractive light. Considerable experience has convinced us that the advantage of a projected picture surround cannot be secured by any manually operated device, however flexible in lay-out and operation.

3. STEREOSCOPIC PICTURE

Present techniques have not reached the stage where it is possible to present a stereoscopic picture to a large audience without making some compromise between what is desirable and what is possible,⁴ and for the Telekinema that compromise involves the

light beams being polarised at right angles by Polaroid filters carried on the projectors.

Requirements of Stereoscopy

The requirements for a stereoscopic picture are that the picture should be seen in depth simultaneously by every member of the audience. This effect, either as in nature or accentuated for dramatic emphasis, must be apparent even in the marginal seats. The brightness of the screen should be adequate from all seats and the whole screen should appear equally bright. This requirement provides conditions which help to pro-

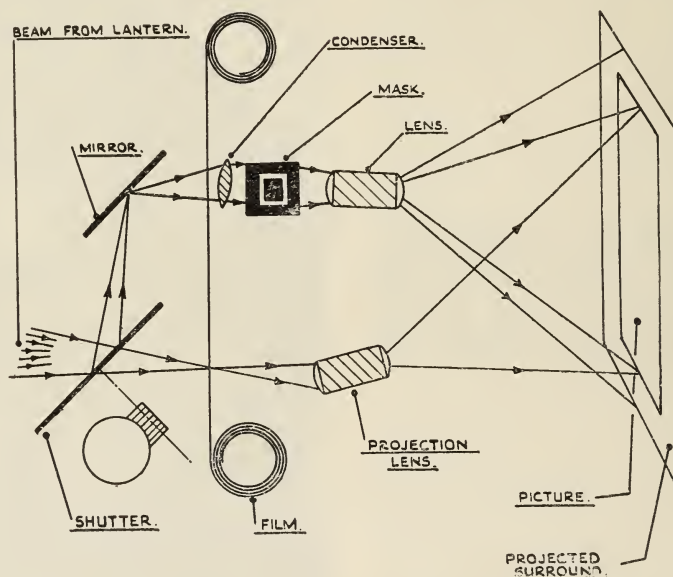


Fig. 2. Diagram showing Principle of Projected Picture Surround.

audience wearing spectacles. Accepting this limitation as necessary, either two-colour spectacles or polarising spectacles can be chosen, and as the latter enable colour films to be presented they have obvious advantages. The right and left eye pictures can thus be kept separated right up to the eyes of the audience, and the basic remaining problem is to decide on how the two images should be stored on the film and projected. For reasons that will be discussed in a later paper it was decided to use two separate films, necessitating the synchronous operation of two projectors, the

duce the stereoscopic effect, which is really due to many factors. The picture projected to each eye must contain the difference due to its particular angle of view, and be so presented that the angular position of the eyes of the audience changes with the near and far objects in the scene.

As the picture appears on a single static screen the eyes of the audience must be focused on it whatever the apparent position of the object. Due to the limited focal depth and power of accommodation of the eye, out-of-focus effects are obtained in ordinary life which aid the stereoscopic view; near

objects are out-of-focus when far ones are seen. In static stereoscopic pictures, the focus is usually sharp all over the picture so that time may be spent in looking from one object to another in the picture, the centre of interest changing. With a moving picture this is less needed, and the principal object only may be taken in sharp focus to accentuate the stereoscopic effect, while the rest is out of focus.

Projection System

In the projection system it is necessary therefore to provide an optical system capable of giving definition sharp enough for the principal object to appear at any part of the screen, leaving the out-of-focus effects to the camera. Apparent depth in the picture is also assisted by a large angle of view, so that no real objects outside the picture come into view to spoil the illusion, for although many of the necessary factors are provided by the projection system it is still the psychological effect in the mind of the observer which fuses the images to produce one three-dimensional picture. This effect can be achieved by projecting each picture in the usual way, except that the two films must be in register on the screen, and must be held in synchronism.

The use of two projectors requires that the lenses of the machines be separated by reason of the size of the machines, and to allow an operator to have access to both machines. This produces a parallax, different in direction for each machine, and the consequent keystone effects in the horizontal plane are in opposition. The right-hand vertical edge of the left eye picture is therefore longer than that of the right eye picture and *vice versa*. This effect also takes place right through the picture, and spatial distortion would be introduced if it were not removed. It is true that this effect is present in the view of a correctly projected picture, but in this case it must be that due only to the inter-lens separation of the camera, which is decided upon by the producer and varies according to the desired dramatic effect. A rectilinear picture free from keystone effects from each machine is

secured by off-setting the lens of each machine, the right-hand lens to the left and the left-hand lens to the right.

As mentioned previously, the right-eye picture is kept to the right eye by using a Polaroid filter between the projection lens and the screen, and by spectacles using Polaroid for each member of the audience. The screen must be capable of reflecting polarised light while retaining the plane of polarisation. The planes of polarisation are 90° apart and this gives transmission to one eye and a complete black-out for the other eye. Each picture is presented twice at 24 frames per second, with a black-out interval between each exposure. We may therefore present the right and left eye pictures alternately so that the screen is always illuminated and a better continuity of vision is maintained than is the case in flat pictures.

The synchronous running of the two projectors is accomplished by the use of Selsyn motors which provide an electrical coupling between the two machines. The Selsyn motors are mechanically coupled at a one-to-one ratio to the normal driving motors. Using this arrangement, the electrical coupling has to take care only of the differences in speed of the two machines, and the torque transmitted from one machine to the other is very low. A chain and small diameter bonded fabric sprockets are used to couple the Selsyn and driving motors to keep down noise to a minimum.

Framing Adjustments

The framing adjustment normally used when the film is incorrectly threaded is now used to bring the two films into position to produce a right and left eye picture in register vertically on the screen. Horizontal register is achieved by lateral adjustment of the film in either gate, an Ardoloy pellet which steadies the guided edge of the film being provided with screw adjustment to effect this adjustment.

In order to produce a rectilinear picture with the brightness curve centrally disposed about the screen centre, the projector mechanism unit was set at an angle to the lantern, so that the plane of the film in the

gate is parallel to the plane of the screen. The lantern gives normal illumination, as its centre line passes through the centre of the picture aperture to the centre of the screen. The projection lenses are mounted in the standard focusing holder with their centre lines normal to the plane of the screen. The projection lenses are mounted offset in the standard focusing holder.

The Screen

The screen has a front surface of fine grain particles, each of which gives a specular reflection and maintains the plane of polarisation. The polar diagram of such a screen stretched flat when set up in a vertical plane has a rather narrow lobe. The screen is therefore curved in the horizontal plane, and coverage is obtained over the whole of the seating capacity with good uniformity of brightness over the whole surface of the screen.

Vibration Insulation

Normally the projectors stand directly on the floor of the operating room, but in the Telekinema the room is located directly above part of the audience. It is necessary, therefore, to mount the projectors on anti-vibration mountings. These mountings are designed to give a periodicity of about 16 cycles per second in the vertical plane in order to be effective in reducing noise transmission to the floor. The machines, being tall in proportion to their width, have a slow torsional period about the fore-and-aft line of the base, and this would have an adverse effect on the picture but for a bridge piece which braces the two machines and holds them together.

With the projectors mounted non-rigidly, it would be reasonable to assume that the picture as projected would be less steady than that from a similar projector rigidly mounted. It is however found, first that the steadiness of each picture is still within normal limits, and secondly that in the stereoscopic picture the remaining movement disappears, giving a remarkably steady picture.

4. STEREOPHONIC SOUND

Present techniques of reproducing sound in the major kinemas have reached a fairly

high degree of perfection, and there appears to be little doubt that further refinements of these techniques are unlikely to arouse any intense public interest, or, to put it more directly, they are unlikely to be good "box office." In spite of this, it must be agreed that no audience could be deceived into thinking that the present electro-mechanical reproduction is the real thing, and as this must be the ultimate target of the sound reproducer designer it was decided to investigate alternatives to present techniques rather than mere refinements, although such refinements are incorporated wherever possible.

Three-Channel Reproducer

Of the various possibilities, the installation of a three-channel stereophonic reproducer, with additional loud-speakers to reproduce special sound effects in the auditorium, seemed to be the most attractive, and after this had been confirmed by an experimental installation in one of the B.T.H. works theatres it was agreed to proceed with an installation in the Telekinema.

Three channels rather than two were chosen because side-by-side comparison indicated the superiority of three, particularly where dramatic action is to be reproduced. The majority of acoustic close-ups always occur in centre stage and the third (centre channel) is invaluable in securing the necessary intimacy. It is noteworthy that Bell Laboratories came to the same conclusion after their tests in America.⁵ The dramatic appeal of sound effects produced in the auditorium, rather than from the loud-speakers behind the screen, was confirmed in first experiments, and at a very early stage in the discussions it was agreed to install additional loud-speakers in the auditorium back walls and in the main and under-balcony ceilings.

Independent Sound Tracks

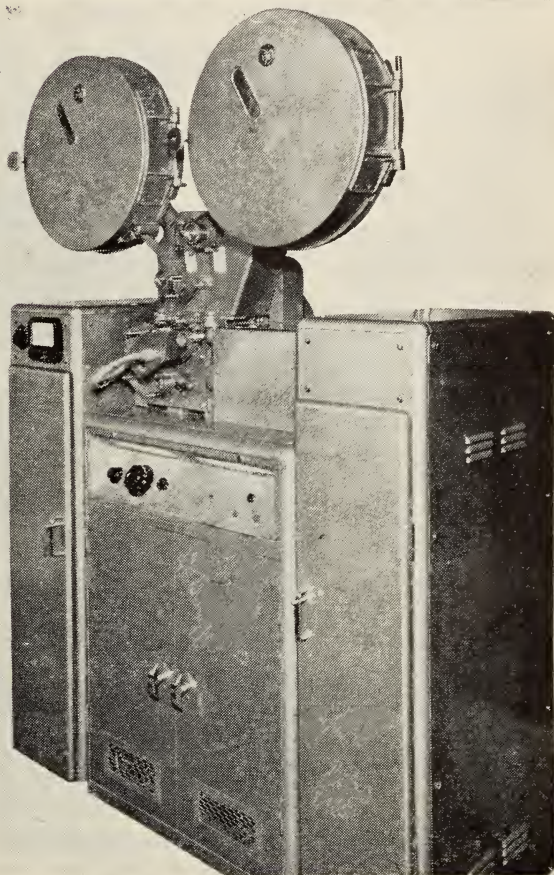
Four independent sound tracks were therefore required, three for the stereophonic sound effects and one for the auditorium sound effects. Although experiment has confirmed that a wide frequency range is less necessary in a stereophonic system than in a monaural system, it was decided to make the system

of wide range. In this and in other respects magnetic recording has considerable advantages over present photographic recording techniques, and though time was short it was decided to develop a magnetic recording/reproducing system for the installation. The work was undertaken in conjunction with Electrical and Musical Industries, Ltd., who provided the magnetic pick-up heads and pre-amplifiers.

for the projection of stereoscopic pictures,

The standard SUPA projectors required only minor modifications in the electrical control system to use them in conjunction with the separate magnetic sound reproducers. Two standard rotary magnetic heads are installed for running magnetic film, each mounted on top of its associated amplifier cubicle, the unit standing a few feet behind the associated SUPA projector.

Fig. 3. The B.T.H. Main Amplifier, together with the E.M.I. Pre-amp Rectifiers, the Control Panel and the Magnetic Reproducer.



The provision of four tracks each of adequate volume range necessitated a separate film for sound only, but as this could be met by a relatively simple assembly of standard units it was no particular disadvantage in this installation. Synchronous locking of the picture and sound projectors is essential when separate machines are employed, but a locking system was necessary in any case

The equipment was manufactured in co-operation with E.M.I. who supplied the reproducing heads and replay amplifiers. The modification of the R.M. heads involved the substitution of the E.M.I. recorder/reproducer head block for the optical scanning system, the addition of a locking Selsyn, and spool-boxes capable of taking 3,000 ft. of film.

Electro-Acoustic System

The electro-acoustic system is fairly conventional, with emphasis on wide frequency range and low amplitude distortion throughout the whole system. Any magnetic reproducer pick-up head has an output which over the major part of the useful frequency range is proportional to frequency, thus a large amount of frequency compensation is required to obtain a flat overall frequency characteristic. This compensation is ob-

the other three amplifiers requires the interchange of wiring plugs, a process that is greatly simplified by the method of mounting and the use of only two plugs for all connections on each amplifier (Fig. 4).

Loudspeaker System

The screen loudspeaker system is fairly conventional, each of the three channels using a standard SUPA combination of two-unit L.F. horns and two-unit H.F. horns

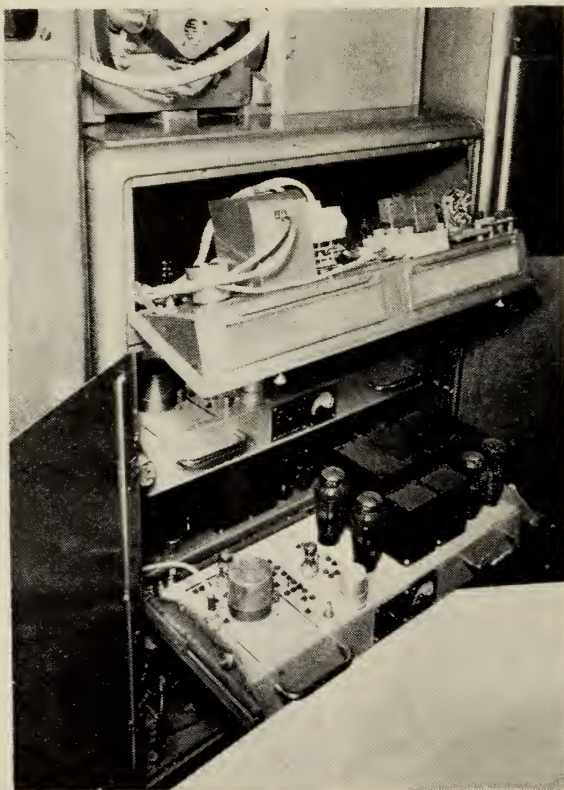


Fig. 4. B.T.H. Mains Amplifier Cubicle open for service.

tained in the E.M.I. pre-amplifiers, which deliver a flat output of 1 mW to the main B.T.H. amplifiers having a power output of 20 watts per channel.

The five amplifiers (four channels plus one spare), the gain controls and control push buttons are mounted in the main amplifier cabinet under the R.M. head (Fig. 3.), provision being made for a "switch interchange" between the centre channel amplifier and the spare unit. Failure of any of

with a change-over frequency of 500 c/s.

The screen speakers are used for all sound film, monaural or stereophonic, the television sound, the interval music, and if the original ideas had matured, for 16 mm. sound also. To reduce the load on the projection room staff, selection of the speaker system appropriate to the picture is made by a switching system incorporating non-linear resistors, an extension of the ideas first incorporated in SUPA. Thus, on a change-over the operator

on the outgoing machine turns his gain control to zero, gives an aural or visual signal to the operator of the incoming machine, who has only to depress his "sound" push button to select the appropriate speakers. These "sound" buttons are located on each machine in close proximity to the gain controls. A loudspeaker selector unit containing the change-over control circuits and the deaf-aid amplifiers is located adjacent to the right hand SUPA machine. It carries indicator lights of different colours which show which speaker system is in operation.

Monitor Speakers

Four monitor speakers of conventional design reproduce sound from the four output channels; those corresponding to the three sets of screen speakers being mounted on the front wall of the box, while the fourth, monitoring the auditorium sound effects, is mounted on the rear wall of the box.

5. CONTROL SYSTEM

When projecting stereoscopic films or using the magnetic sound heads it is essential to operate two or more machines in exact synchronism from standstill. Normal synchronous drives are insufficiently accurate to maintain such exact correspondence even though the films are correctly framed when threaded, but the application of a Selsyn interlock system makes it possible to obtain the synchronisation necessary in a relatively simple manner.

Selsyns are similar to A.C. induction motors, with wound rotors and stators, the stator winding being energised from the mains while the rotors of the two Selsyns to be interlocked are connected in parallel. The stator windings induce mains-frequency voltages into the rotor windings and the two rotors move relatively until the voltages induced in the two rotors balance each other with no current flowing in the rotor circuit. If one rotor is turned mechanically, the rotor of the second machine will move to keep the same relative position, and this occurs even with the rotor turning at 1,440 r.p.m.

The Telekinema requirements are met by mounting a Selsyn motor adjacent to each driving motor, the two motors being coupled

by a roller chain drive. Correct phasing at standstill is achieved by supplying single-phase excitation to the stators before film threading commences, and on depressing the "start" push button all interlocked units will run up in exact synchronism. As the number of machines in operation depends on the programme being presented all the control switches are grouped together in a Selsyn selector panel, thus permitting the operator to verify at a glance the combination selected for operation.

Change-over Devices

The light and sound change-over devices on the standard SUPA equipment are electrically operated, depression of the "change-over" button on the incoming machine opening the "incoming" shutter and closing the "outgoing" shutter. This facility is retained in the Telekinema equipment, but the arrangement has to be modified when projecting stereoscopic films, as both machine change-over shutters must open or close together. Appropriate arrangements ensure that switching of the equipment to the "stereoscopic" position automatically closes both machine shutters. During stereoscopic operation the normal change-over push-button operates both shutters in phase, i.e. they open together.

This completes a rather brief description of the Telekinema equipment, but it is probably true to say that it represents an advanced view of the projection room of the future, embodying some of the equipment that will undoubtedly prove essential if the kinema is to retain its present pre-eminent position.

Acknowledgments

The authors would acknowledge the efforts and ideas of several other engineers in the B.T.H. organization who have contributed to the design of the equipment, and would also mention the co-operation of the factory personnel in producing the equipment in the relatively short time allowed.

Our thanks are also due to Mr. H. Jack, Director and Chief Electrical Engineer of the British Thomson-Houston Co., Ltd., for permission to publish this paper.

THE DIRECTOR'S PROBLEMS

Ken Annakin*

Read to a joint meeting of the British Kinematograph Society and the Royal Photographic Society on November 24, 1950.

FILM making is a co-operative art and the director's function is to act as a liaison for all the ideas which come from all sources during a production, both on the studio floor and during conferences before.

In the first instance the director has to read the basic simple outline of the story and allow mental pictures to pass through his mind. He acts as a kind of sieve, sorting out what appears good and what he thinks bad. Only one man can say what shall finally appear on the screen, and that man is the director. The picture will, therefore, reflect his outlook on life and his way of seeing things. This is the factor that makes each director's work recognisably different.

Preplanning Production

In the pre-production period I make small working plans on the left-hand side of my script. This gives me an idea of the basic set I shall require. This is then discussed with the art director, who adds his own ideas and states what is economically possible in properties, according to the amount of money he has at his disposal.

In working out the shots it is necessary for me to draw on my technical experience, in order that impossible and time-wasting tasks are not set for the camera and sound crew. The microphone has to be kept close to the artistes during dialogue and the lighting cameraman has to provide "holes" in his lighting plan for the microphone to drop into, where shadows will not be cast visible in the picture. After a while this type of consideration should become automatic to the director.

The technique with which films are made should be completely unobtrusive. The audience should never be able to comment upon specific camera movements; this de-

tracts from the story. What the camera does should appear to be most natural and be the inevitable thing for it to do.

Scripting

There are usually good reasons for alterations from a story written first as a novel. The characters have to be established visually rather than by description. In the case of W. Somerset Maugham's story, "The Colonel's Lady," the dialogue could be transferred almost intact to the screen, but certain cuts had to be made from the original conception in order to condense the film to the allowable footage.

In passing, I would like to say that the short story is the ideal medium for a film director to work on, for it is usually short enough for him to keep the whole story easily in mind throughout the shooting. It always allows for full and warm characterisation because the plot is usually simple. In my opinion, it does not matter whether a story has been specially written for the screen or whether it is a classic, so long as it lends itself to being told by the camera. The stories of Somerset Maugham invariably do, and his dialogue is the most speakable of any screen-writer I know.

The Production

There are certain subterfuges which assist in keeping down production costs. The back-projection plate used in the train journey in "The Colonel's Lady" was taken from the library. The action when the train stopped at the station had to be matched with the plate. A back-projection plate usually loses quality, and it is necessary therefore, to avoid dwelling too long on such a shot. To assist the cameraman's difficulties of focus the director always tries to keep

* J. Arthur Rank Organisation, Ltd.

Fig. 1. Scene showing the Set of the London Club Scene in "The Colonel's Lady."



the artistes as close as possible to the screen.

The scene of the cocktail party in "The Colonel's Lady" was shot in one four-minute take. This is probably the best sequence I have ever shot. This does not mean to say that I favour long takes; in principle I would be inclined to say that they

fetter the director to theatrical presentation and lose for him that unique quality in film—selectivity. In this cocktail party I believe the atmosphere of the party was successfully captured because the camera kept a continual flowing movement, matching the gyrations of the people present.

Technical Details

The following are the notes I made for the scene in the interior of the London club. The sketch shows the camera movements.

The Colonel enters at the door (angle 1), the camera pans him to pause (angle 2) and we held the set in order to get the atmosphere for a second. He then moves left and camera pans with the Colonel to arrive on two club-men (A) gossiping in foreground (angle 3). The Colonel (B) joins them and they talk. A fourth man (C) approaches, but comes sharply into focus only when he is needed, *i.e.* on arrival beside B. They turn back to camera and walk away down the room, the camera tracking after them and the focus is thrown on to the critic (D), an odd, eccentric figure whom we want to see and laugh about before the Colonel (B) and his friend (C) reach him. After a brief three-shot (angle 4) B and C move out right and the camera holds close on the centre (D) as he sits and talks.

The film "The Colonel's Lady" was then projected.

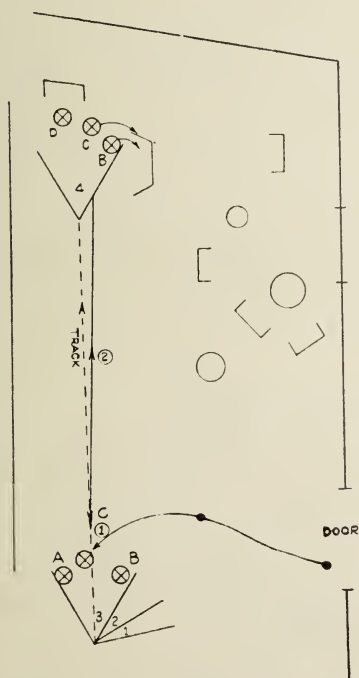


Fig. 2. Sketch of Camera Movements In London Club Scene.

HOW SHOULD WE DEVELOP BRITISH TELEVISION?

C. Ian Orr-Ewing, O.B.E., A.M.I.E.E., M.P.*

Report of paper presented to a joint meeting of the British Kinematograph Society and the Television Society on March 7, 1951.

MR. ORR-EWING first stressed that he was not speaking for any political party, but for himself. He said that few people in this country realised how fast American television had travelled since 1941. They had 107 television stations operating, and in New York alone viewers had a choice of seven programmes, from early in the morning until midnight.

From careful study, he believed that the picture quality as it left the transmitting stations here and in the U.S.A. was about equal, but that pictures as received in the home by British viewers were slightly better in quality than those received by the Americans.

In one sphere, British television was quite outstanding—the picture quality of films transmitted was far ahead of the American equivalent, and he believed incidentally that the British newsreel was better than any of the U.S.A. counterparts he had seen.

It was sad to think that the B.B.C. had still only four television studios, whilst in New York alone there were over 80. Few people realised how widespread were the U.S.A. television networks. There was no noticeable loss in picture quality when watching programmes relayed over 800 miles. By the end of this year, they would be relayed over 2,600 miles. If we could do that here, we should be looking at programmes from Persia, in place of Calais.

Competition in Programmes

It was essential that British television should develop more rapidly in the future if we were to achieve exports both of equipment and of filmed programmes. Mr. Orr-Ewing believed two things were essential: competition and a limited sponsorship.

First, a pacemaker must be created for the B.B.C. It was no reflection on the present monopoly to suggest it needed

a pacemaker; good racehorses, athletes and firms, all needed the stimulus of competition to give of their best. If this pacemaker were provided, then it would probably not be necessary to cut the Television Service loose from the dictates of Broadcasting House. On the principle that a small Corporation moves more quickly than a big one, he believed television would have progressed more quickly if it had not been tied to sound.

He visualised a National Television Company to compete with the Television Corporation, and to provide the alternative programme which it was essential in the future must be offered to viewers. To provide these extra programmes without an undue increase in the licence fee, he believed the new Company should be free to make use of programmes from sponsored sources. On the question of finance, he thought that licence fees should be paid to a British equivalent of the Federal Communications Commission, which would license stations and lay down technical and programme conditions under which they should operate. It would then allot the bulk of its money to the B.B.C., but would be free to allot a portion to assist companies providing the alternative programmes. The Beveridge Report contained many good proposals on the methods.

Systems of Control

Mr. Orr-Ewing then outlined a “ladder” of possible organisations in order of their desirability from his point of view. He realised that there might be difficulties in view of the rearmament programme, but he hoped that Parliament would land on the highest possible rung. The various rungs of the ladder were:—

Bottom Rung.—Present single Corporation with television under Broadcasting

* Member of Parliament for Hendon (North).

House, and with permanent Charter—as advocated in the Beveridge Report.

Rung 7.—As at present, but with a Committee of Investigation every five years.

Rung 6.—A separate Television Corporation with a single National Programme, as outlined in the B.B.C. plan.

Rung 5.—Television Corporation, providing the National Programme and having equipped regional studios and O.B. Units which can use their own programme sources locally, or can feed the National network.

Rung 4.—A Television Corporation, but accepting programmes from National and sponsored sources, i.e., competition on a time-sharing basis, similar to Canadian broadcasting.

Rung 3.—(i) British Television Corporation, giving a National Programme.

(ii) National Television Company, or Corporation, giving a light television pro-

gramme, and making use of sponsored programmes and regional talent.

Rung 2.—(1) A British Television Corporation, providing the National Programme with regional variations.

(ii) A National Television Company, providing an alternative programme.

(iii) Local television stations providing a third programme.

Rung 1.—To be fashioned in the light of experience.

Mr. Orr-Ewing, in his conclusion, said that television, in its entertainment, educational, industrial and commercial, defence and kinema rôles, could, given international peace, develop enormously within the next twenty years. He hoped that when this was discussed in Parliament, it would be realised that we were human and fallible and that this organisation must be so fashioned as not to restrict its growth in any direction.

DISCUSSION

Dr. WILLIAMS: At the moment we are using a carrier wave of 45 Mc/s, in the lowest of a number of bands which have been internationally allocated for television. There is another band a little above with a higher frequency, which is spoken of as Band 3, and above that again, there is a vast and, at the moment, unexplored region of round about 400 Mc/s. In this country, we have spread our existing planning for our five stations over the very lowest of these bands. We are not planning to use Band 3, the next one.

America has spread her 13 channels over both the band we are using and Band 3, and at the present moment they are arguing fiercely as to how they are going to use this unexplored band—originally allocated for colour and experimental uses—at even higher frequencies. On the Continent you have experimental stations already in Band 3, and undoubtedly there will be also other stations there; there are some of them at the moment in the lower band.

To some extent, we are chancing our arm in this country in thinking that we have got a monopoly of that band, and that stations subsequently opened on the Continent will not in some way interfere with us.

I would like to underline Mr. Orr-Ewing's point that there is no need to spend quite as much money as we do in this country in giving an entertaining television programme. In one Continental country there has been running for some years an experimental transmission which operates on three week-nights and on Saturday night, and that is done in a total studio space of about a third of this room we are in here. It contains three cameras, the transmitting equipment is housed in an ordinary building, and the mast is in fact just stuck up on the roof,

Mr. BRIDGEWATER: Does Mr. Orr-Ewing really think that in the future there will be forthcoming sponsors with money and goods to offer? Money to pay for the programmes, and goods to advertise. (Laughter.) In spite of the protests of Mr. Orr-Ewing's party in the House, the Government is pressing ahead with nationalisation, and if we have more of that, presumably the sponsors can only come from the ranks of nationalised industry,

THE AUTHOR: I think there will always be something that the Government of the day will want to put over.

Mr. ROSE: Can Mr. Orr-Ewing tell us who are these mysterious people who are opposed to sponsored programmes?

Mr. ORR-EWING: The Lord President of the Council said in the House of Commons that he would use every possible means at his command to stop Radio Luxemburg transmitting programmes which could be heard in this country.

Mr. W. S. BLAND: On the question of television in cinemas, the speaker says he does not think there is much future to the propagation of features in cinemas, but thinks there is some use in putting out spontaneous news items. If the feature industry cannot afford to pay for the vast amount of equipment which would be involved in producing the distribution networks, I cannot see that the short time that can be devoted to the news will be able to stand the expense.

Even if there is any objection to the use of television in cinemas, I cannot see any reason for objecting to the use of television as a production tool—for instance, picking up the Derby and relaying it back to headquarters, to get it on the screen the same night,

BRAINS TRUST ON THE KINEMA

The meeting of the B.K.S. Theatre Division of February 11, 1951, consisted of a Brains Trust. The Question-master was Leslie Knopp, Ph.D., M.Sc, F.I.E.S., F.R.S.A. (Fellow)* and the members of the Brains Trust were :

A. E. Ellis (Member)†

W. F. Garling (Member)‡

L. W. J. Henton, A.I.H.V.E. (Member)§

S. Kadleigh¶

J. W. J. Leslie, A.M.I.E.E. ||

R. R. E. Pulman (Fellow)§

The Question-master in opening the proceedings stated that a number of interesting questions reflecting modern conditions and thoughts had been received, and it was hoped that they would prove of interest to all those who were present. Recently the Home Secretary had issued in the form of a statutory instrument the new Regulations for the electrical installation and large screen television equipment in cinemas. The thought that no doubt prompted the first question arose from the fact that these Regulations required that all equipment and material used in electrical wiring of cinemas comply with the appropriate specification of the British Standards Institution.

Does not the Trust consider that the standardisation of equipment and material retards progress and is, therefore, not in the interest of the user? If the answer is in the negative, has the Trust any recommendations to make for standardising cinema equipment?

Mr. PULMAN: If standardisation becomes standardisation for its own sake, then there is something in the question of retardation of progress. The essence of the whole matter is to know exactly where to draw the line. In my experience I have never found that the designers and manufacturers are shy in lifting their voices immediately anybody unnecessarily restricts design or manufacturing uses. Therefore, I believe that the answer is in the negative.

With regard to the second part of the question I think the answer is that one should standardise as much as is possible in this industry.

Mr. LESLIE: I agree with Mr. Pulman. I think dimensional standardisation could be adopted where motor frame designs, starter, switch-gear and fuse board cases are concerned, without touching, so to speak, the essentials of the equipment. This would permit easy interchangeability without extensive disturbance to the installation. I think that if agreements could be reached on points like this it would be a step towards progress.

Having regard to the Wellsian architecture of the Festival of Britain which has blighted the Thames-side, does not the Trust consider that this is the 'shape of things to come' in cinema design?

Mr. KADLEIGH: This is a difficult question which requires a certain prophetic vein. If you take it seriously, the design of any building or structure is vested in the imagination of the architect. It is the culmination of many different points of view, starting with the philosophy of its promoters, the imagination of the individual who is entrusted with its creation and assisted by the developments of the building and allied industries. None of these is static, and therefore it is improbable that you will see a repetition of present styles in the future. I think that if the Festival is highly successful it might start a fashion which may show itself in buildings for a considerable period.

If for financial or economic reasons it is not possible to construct and equip a cinema in the highest standards of quality and efficiency, would the Trust recommend an overall reduction of quality, or would it recommend perfection in some respects and a low standard in others? If the latter, on what sections should the savings be made?

Mr. PULMAN: We are in the show business to show motion pictures, and as far as projection and sound reproduction are con-

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† Print Manager, Associated British-Pathé, Ltd.

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§ Projection Engineer, Circuits Management Association, Ltd.

¶ Consulting Architect, British Film Institute,

|| Consulting Electrical Engineer,

cerned these should be maintained at highest level. Saving should be outside the projection and sound reproduction, and outside the comfort of the patrons of the kinema.

Mr. GARLING: I agree with Mr. Pulman. If you are showing sound pictures, you must have as near perfection as possible. The difference in cost between the best and second best is so small that there would be no appreciable saving. Next comes the comfort and safety of the patrons. Therefore, any savings should be made in cutting down costly adornments. The foyers and such-like public spaces should be strictly utilitarian.

Mr. KADLEIGH: From the architectural side of the building, considerable economy can be effected by very careful planning. I feel that if only the architect and the technical consultants can get together in the initial stages and if they put a great deal of thought into the planning of the auditorium and all the ancillary rooms, stores, staircases, etc., the greatest economies can be effected. Initial economy is not necessarily true economy; in other words, the lowest capital cost need not necessarily lead to the greatest economy. You cannot economise on structure as such, but effective and efficient layout can prevent subsequent waste of money and effort.

Mr. LESLIE: The new Cinematograph Regulations prevent any economy on electrical installations. Continuity of programme, public safety, etc., are closely wrapped up in the electrical installation. I think the new Regulations have gone a long way in the right direction. Some economy could be made in the elaborate lighting schemes.

QUESTION-MASTER: The Trust have given a particularly good answer to this question; they have spoken in a very restrained manner without having forced their own sections unduly. They have come to the conclusion that the prime requirements upon which no economies should be effected are in the quality of the picture projection and the sound reproduction. Our architect gives the view that, providing one is prepared to make adequate capital expenditure with a view to ultimate maintenance economy, the over-

all costs of running a kinema could be materially reduced.

The Trade Press has recently announced the formation of a new Committee to counter film mutilation. In view of the number of attempts that have been made in the past to reduce film mutilation, has the Trust any reason to suppose that the new Committee will be more successful than its predecessors?

Mr. ELLIS: I think the answer must be a definite "yes." We have had these committees in the past and I resent the inference that they have not been successful. The new Committee is formed by representatives of all sides of the industry and naturally we should get more co-operation. Whereas in the past we have not had a wide authority to proceed, in this particular case I think we shall be in a stronger position.

Mr. PULMAN: I believe that the fact that previous Committees were not entirely successful was due to the fact that they were not completely representative. This Committee will have members from every organisation, and I think we should make a useful contribution to the well-being of the industry.

Is the Trust in favour of a change in requirements of the earth continuity path from 1 ohm resistance to 1 ohm impedance?

Mr. LESLIE: There is a difference between impedance and resistance. Impedance of a circuit includes both resistance and reactance. Resistance depends on the length of the circuit, the cross-sectional area and the nature of the material used. The reactance is concerned essentially with the shape of the circuit. Most earth continuity paths are direct and I do not think reactance is of material importance. But most supplies in this country are alternating current and therefore there is a possibility that there will be some slight reactance in the circuit.

To measure the reactance of the circuit A.C. testing equipment is necessary. I do not suppose anyone will bother to invest in this, but will go on using the ordinary continuity tester which is operated by a battery,

and so resistance only will continue to be measured.

I was a little mystified by this change in name. At first I thought it had something to do with the inclusion of the earth leakage tripping coil where reactance forms an important factor, but this is not so because in another part of the Regulations the total impedance of the earth continuity path specifically excludes this earth leakage tripping coil. I do not think it matters whether the term used is resistance or impedance, because in practice resistance only will continue to be measured.

Regarding the question how are earth leakage trips to be designed in order to comply with the new requirement. First, you can already buy earth leakage trips—they are designed. It is not necessary to fit those to ordinary circuits. It is only when the earth continuity path is of such resistance that the forthcoming fault would not blow a fuse, and I think it is only necessary to fit these for circuits of over 100 amps., providing you comply with the regulation as to the impedance or the resistance of the earth continuity path.

Mr. GARLING: As far as the sound equipment is concerned, I cannot see that it matters at all whether it is 1 ohm resistance or 1 ohm impedance. Also as far as the sound equipment is concerned, from the slight amount of study I have been able to give the subject, I think that we are not interested in trip devices because we can claim that in all cases, fuses would blow.

Mr. LAMBERT: Would Mr. Leslie, in his capacity as a Consulting Engineer, be prepared to make a D.C. resistance measurement of the earth leakage path and to certify that the impedance is less than 1 ohm?

Mr. LESLIE: Yes, I would. The earth continuity path does not include the resistance of the earth as well—it does not include the earth leakage trip.

The new Cinematograph Regulations require rewinding apparatus to be earthed. Does the Trust consider that experience proves this requirement to be necessary?

Mr. PULMAN: My personal experience proves this to be entirely unnecessary. I think that everybody will agree that a spark from static electricity will not ignite nitrate film. I believe some time ago there was a fire in France, and finally the conclusion was reached that it was caused through discharge of static electricity, but I think again there was some question involved in the processing of the film, and I believe the idea of this requirement is that a nitrate film might be processed with some sort of liquid that might give off a gas which could be ignited by a spark. But I am very sceptical about the whole thing.

Mr. ELLIS: I have seen static occasionally, and I have not come to any conclusion that it would be dangerous. Mr. Pulman has mentioned a fire in France, but I am very much inclined to think that that static was possibly a cigarette. I do not think it could be proved that static is dangerous or could ever cause a fire. However, if the Regulations say we must earth the equipment, we must do so.

QUESTION-MASTER: A large number of tests have been carried out with the object of igniting film whilst it is being rewound. Using new or good quality of film, rewinding at very high speed, and causing considerable friction with blocks, etc., we have been able to generate the most remarkable display of static discharge. We were, however, unable to ignite the film; nevertheless, we did find that where certain types of cleaning material had been used and the film was re-wound shortly after coming off the projector and, therefore, was warm, inflammable gases were given off which the static discharge could ignite and, indeed, where the film was in its first stages of decomposition, the gas flash was immediately followed by a very substantial explosion. I think, therefore, that it is very wise to earth these winding heads, particularly in view of the fact that there are a large number of kinemas in the country which show old films which have been similarly cleaned and where there have been these mysterious fires. In many cases the projectionist has very wrongly been under suspicion of smok-

ing in the rewinding room, when in fact, he has not been at fault.

Should the ventilation system in cinemas be of the upwards or downwards draught type? Would the Trust give its opinion of the advantages and disadvantages of the down draught system?

Mr. HENTON: The answer is neither. I will deal with the second question first. The upward system is obviously going to cause the dust to rise, and people have to inhale it. The second objection is that the air introduced into the auditorium is at a slightly lower temperature than that inside, therefore it is uncomfortable, especially for ladies who are thinly clothed.

The downward system, which is preferred in America, is entirely objectionable in this country, mainly because we smoke. To clear the smoke it is necessary for the air to move at a certain rate; if it moves at that rate a draught is produced. Where we come to the question of the velocity of air movement, the movement is first effected by propellers or fans, and also due to its temperature in relation to the auditorium temperature. If the air is warm inside it will go out fairly slowly, but if it is higher it will move faster; therefore it is difficult to keep a uniform speed.

In view of the smoking habit in this country, I find it far better for the air to be given a sharp horizontal movement, causing it to move fast enough to maintain its direction of flow. Finally the downward system is much more costly than other types and further, a secondary apparatus is required to reverse the draught in case of fire.

As the film picture area has rounded corners and it is generally considered that curved objects are aesthetically more acceptable than straight lines, can the Trust give the reason for the present-day preference for square corners on so many cinema screens?

Mr. PULMAN: I think the answer is that once upon a time somebody must have found that the corner pieces that are used to give rounded corners to screens became de-

tached, and probably they had not got a ladder to replace them, and then somebody perhaps saw the right-angle corner picture and decided that a revolution in motion picture screens had arrived. That is the only conclusion I can possibly arrive at in suggesting how it all came about.

Mr. KADLEIGH: I do not entirely agree with the question that curves are obviously better aesthetically than straight lines. I think they have an equal merit; you can make just as good a design with straight lines as you can with curves. I think aesthetically that it does not matter whether you have square corners or curves. You can make an equally good proscenium arch and an equally good auditorium with either. What does matter is the proportion between the length and height of the picture and the size of the screen in relation to the size of the auditorium. If you have too small or too large a screen it is uncomfortable, and there must be a direct and quite scientific relationship between the size of the auditorium and the size and brightness of the picture. Needless to say, the sight lines from each seat should be correct.

Mr. ELLIS: I do not understand why some theatres have square and some round corners but there is one point—the camera aperture, printer aperture and most projector apertures—all have rounded corners.

Having regard to the fact that the public are accustomed to poor quality of sound from the normal household radio receiver, does the Trust consider that optimum sound quality in cinemas is unnecessary because it is not appreciated by the public?

Mr. GARLING: Whilst I think we can agree that home radio receivers do not have a fidelity comparable with that which can be obtained from up-to-date sound film reproducer equipment, I think it is wrong to try to use the lower standard as a basis for deciding that you do not need optimum sound reproduction in cinemas. First, in the home you have an entirely different set of circumstances: rooms are small, acoustics are probably reasonably good, you have no picture—as long as we are not con-

sidering television—and I think in spite of the fact that the quality of reproduction is, generally speaking, not good, still the intelligibility of speech or dialogue is probably satisfactory from most home receivers.

Because of that fact I think that the questioner may have lost sight of the fact that in a larger auditorium such as the kinema, the intelligibility is to a very considerable degree tied up with fidelity of reproduction, and where, at least in so many instances, the fidelity is poor, intelligibility is also poor. Where that is the case the patron does not get satisfaction.

Furthermore, in the kinema there is a large picture, and where there is a picture you are quite aware of the setting; if you have a large orchestra or a chorus, you can

see the individuals singing or playing; if you are in a vault, you can plainly see you are in a vault and you expect certain results. I think in such a public place the patrons have preconceived notions as to what the sound normally would be like, and, therefore, if it varies widely from what they have preconceived, they do not get the same satisfaction. I think, therefore, that it is a mistake for anyone to under-estimate the intelligence or taste of individuals as regards the quality of sound reproduction, and that it is important that the highest possible fidelity be obtained if you wish to cater for the general public.

Mr. KADLEIGH: I consider that the policy because one thing is bad to make the other thing bad also, is completely untenable.

TECHNICAL ABSTRACTS

The following abstracts are printed by courtesy of Messrs. Kodak Ltd.

CRYSTALLOCHEMICAL MECHANISM OF THE FORMATION AND DEVELOPMENT OF THE LATENT PHOTOGRAPHIC IMAGE

P. D. Dankov, *J. Phys. Chem. (U.S.S.R.)*, No. 9, 1949.

A theory of latent-image formation and grain development is given which combines most of the features of the Gurney-Mott scheme with proposals previously made by the author. An observation of fundamental importance, which has been neglected by Gurney and Mott, is the excellent correspondence of the atoms in the silver and silver bromide crystals in certain planes. In latent-image formation, the trapping of an electron by the metallic nucleus and the subsequent diffusion of metal ions in the electron field, as suggested by Gurney and Mott, are not necessary. A more probable scheme permits an electron which is approaching the nucleus to combine with an ion, and the neutral atom will add to the nucleus. The shortage of metal ions created near the silver-silver bromide interface will set up a diffusion (not induced by an electrical field) of metal ions towards the nucleus. At the same time, diffusion of "positive holes" will occur away from the latent-image nucleus towards the grain surface. The existence of electrical fields during the flow of charged particles is of secondary importance. In addition, sensitivity specks are of importance only because of certain crystallochemical reasons, and not for the reasons proposed by Gurney and Mott. The crystallochemical idea is elaborated by a detailed description of the positions and motions of atoms in the region of the silver-silver bromide interface formed at (100) planes in the two crystals. According to this scheme, the silver is continually forced away from the interface by migrating silver ions and electrons. The same picture is used in describing the development process, except that electrons are supplied to the nucleus from the developer. A development scheme of Faerman, which proposes that silver is deposited from solution on the free surface of the silver nucleus, is criticized, since it does not explain the observation that the halide grains may be forced away from the silver growth which appears on development.

C. R. B.

ASHCRAFT COLOR METER

J. Biol. Phot. Assoc., No. 1, February, 1950.

To use the Ashcraft Color Meter, a dial is set for the desired color temperature. The meter is pointed at the light source, or at a white card (supplied) if used outdoors, and color-correction filters (not supplied) are placed in front of the photocells until a filter is found which causes the meter needle to rest at zero. This filter is then used on the camera.

B. M. S.

LIBRARY NOTES

The lists printed below show the periodicals available to members in the library at 117, Piccadilly. The first is a list of periodicals published in the United Kingdom and the second of those of foreign origin, showing the country in

which they are published and the language in which they are printed. In most cases not only is the current issue available but a certain proportion of back numbers is retained

Periodicals published in Great Britain

AMATEUR CINE WORLD
ARC
BRITISH FILM ACADEMY QUARTERLY
BRITISH INSTITUTE OF RADIO ENGINEERS JOURNAL
BRITISH JOURNAL OF PHOTOGRAPHY
BRITISH STANDARDS INSTITUTION MONTHLY INFORMATION SHEET
CHURCH AND FILM
CINEMA STUDIO
COLONIAL CINEMA
DAILY FILM RENTER
ENGINEERING INSPECTION
FILM SPONSOR
FUNCTIONAL PHOTOGRAPHY

G.E.C. JOURNAL
INSTITUTE OF BRITISH PHOTOGRAPHERS RECORD
IDEAL KINEMA
KINEMATOGRAPH WEEKLY
NICKEL BULLETIN
PHOTOGRAPHIC DEALERS ASSOCIATION JOURNAL
PHOTOGRAPHIC JOURNAL
PHOTOGRAPHIC TRADE BULLETIN
ROYAL SOCIETY OF ARTS JOURNAL
SIGHT AND SOUND
SUB-STANDARD FILM
TELEVISION SOCIETY JOURNAL
TO-DAY'S CINEMA

Periodicals published outside Great Britain.

Title	Country of Origin	Language
A.G.I.S. BOLLETTINO D'INFORMAZIONI	Italy	Italian
AMERICAN CINEMATOGRAPHER	U.S.A.	English
ANSCONIAN	U.S.A.	English
BELL TELEPHONE MAGAZINE	U.S.A.	English
BELL SYSTEM TECHNICAL JOURNAL	U.S.A.	English
BENGAL MOTION PICTURE ASSOCIATION JOURNAL	India	English
CÁMARA	Spain	Spanish
CANADIAN STANDARDS ASSOCIATION QUARTERLY	Canada	English
CINÉOPSE	France	French
CINEMA D'OGGI	Italy	Italian
BULLETIN DE LA COMMISSION SUPÉRIEURE TECHNIQUE DU CINÉMA	France	French
DOCUMENT REPRODUCTIE	Holland	Dutch
LE FILM FRANÇAIS	France	French
FILMFRONT	Holland	Dutch
DAS FILM-TECHNIKUM	Germany	German
FOTO-KINO-TECHNIK	Germany	German
INTERNATIONAL PHOTOGRAPHER	U.S.A.	English
INTERNATIONAL PROJECTIONIST	U.S.A.	English
KODAK INFORMATION	U.S.A.	English
LA PELICULA	Mexico	English
MASSEGNA DELLO SPETTACOLO	Italy	Italian
PHILIPS TECHNICAL REVIEW	Holland	English
PHOTO-SERVICE GEVAERT	Belgium	French
PHOTO-TECHNIK UND- WIRTSCHAFT	Germany	German
RCA REVIEW	U.S.A.	English
SCIENCE ET INDUSTRIES PHOTOGRAPHIQUES	France	French
SHOWMAN	South Africa	English
SHOWMAN'S TRADE REVIEW	U.S.A.	English
STANDARDISATION	U.S.A.	English
JOURNAL OF THE SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS	U.S.A.	English
TECHNICOLOR NEWS	U.S.A.	English
LA TECHNIQUE CINÉMATOGRAPHIQUE	France	French
UNI-FRANCE FILM	France	French
UNITALIA	Italy	English

THE FATHER OF MODERN PHOTOGRAPHY

An exhibition of the work of Fox Talbot, "the father of modern photography," designed by Dr. D. A. Spencer, Hon.F.R.P.S., was opened by Miss M. T. Talbot, C.B.E., at the Kodak showrooms in Kingsway, on April 23.

Fox Talbot's first "photogenic drawings" were made in August, 1835, at Lacock Abbey. His earliest cameras were wood boxes, about 2ins. square, with a hinged back and a lens; this form of camera—styled by his wife a "mousetrap"—is the direct ancestor of the modern box camera.

The first photographs were made by a printing-out process, but in 1840 he discovered the process of development, using gallic acid, which enabled the camera exposure to be reduced from hours to minutes. The paper negatives were waxed and positives made by contact printing, and fixed in common salt. For enlarging, Fox Talbot re-photographed his positive, using a large camera,

and then made contact prints from the resulting large negative.

For mass-production photographs for the purpose of book illustration, numbers of printing frames were exposed to daylight. A photo-mechanical method of printing, employing bi-chromated gelatine, was in its basic features identical with the photogravure process.

Among other technical applications of photography to which Fox Talbot turned his attention were flash photography—using a spark from a large bank of Leyden jars—and document copying. The use of filters was anticipated, although with his non-colour-sensitised emulsions the only filter he was able to use was one to remove heat.

Photographs and equipment representative of all these processes are demonstrated in the Kodak exhibition, alongside their modern descendants.

R. H. C.

THE COUNCIL

Summary of meeting held on Wednesday, April 11, 1951, at 117 Piccadilly, W.1

Present : Mr. A. W. Watkins (*President*), in the Chair, and Messrs. L. Knopp (*Vice-President*), E. Oram (*Deputy Vice-President*), H. S. Hind (*Hon. Treasurer*), D. Cantlay, B. Honri, T. W. Howard, N. Leever, R. E. Pulman, S. A. Stevens and R. J. T. Brown (*representing Papers Sub-Committee*).

In Attendance : Miss J. Poynton (*Secretary*).

COMMITTEE REPORTS

Social Committee.—Some 400 Members and Guests attended the Dinner at Grosvenor House on April 4, which was a most successful event. The financial aspect of the Dinner is satisfactory. The final account is not yet complete, but it appears that the income and expenditure will approximately balance.—*Report received and adopted.*

The Convention.—The President-Elect, Mr. L. Knopp, will deliver a Presidential Address at the Annual Convention on May 5. The Divisional Annual General Meetings and the Ordinary Meeting of the Society will take place at the same times as last year, and a programme of films for the entertainment of those not attending the meetings will be shown from 3 p.m. onwards.—*Report received and adopted.*

Library Committee.—A regular allocation of space in the Journal for publishing Library matters is one feature in the campaign for promoting its wider use. Copy concerning the various aspects of cinematography and its allied techniques as relating to the Library will be contributed by specialists within the industry.

The industrial shelving has now been replaced by mahogany bookcases and a new library cata-

logue is to be published.—*Report received and adopted.*

Papers Sub-Committee.—Preliminary consideration has been given to the date schedule and the Divisional and Society meetings for the 1951/52 Session.

The 16 mm. Film Division will base its papers on the Investigation Committee's reports. The Film Production Division is again forming its papers into a series under the main title "Long Term Developments in the Industry."—*Report received and adopted.*

16 mm. Film Division.—Reports from the Chairmen of the Investigation Technical Sub-Committees have been received.

Laboratory tests and the drafting and circulation of questionnaires, although time absorbing, are necessary adjuncts to a comprehensive survey. It is hoped that Part I will be completed shortly.—*Report received and adopted.*

Theatre Division.—Further progress is being made with the 1951/52 lecture programme, in which is included a demonstration of Philips' equipment.

The following *ad hoc* Committee is appointed to make recommendations for examination purposes in connection with the Apprenticeship Scheme for the Training of Projectionists: Messrs. H. Lambert, S. J. Perry, R. E. Pulman and F. H. Sheridan-Shaw.—*Report received and adopted.*

Film Production Division.—Final arrangements for the visit to the B.B.C. Television Studios, Lime Grove, on Saturday, May 19, have been concluded.—*Report received and adopted.*

A Festival Year Plaque.—During Festival Year an oak plaque will be affixed to the wall of 92,

Piccadilly, to commemorate William Friese-Greene's invention of the motion picture. The design has been approved and it is hoped later on to replace it with a bronze plaque.

Television.—Arising from divided opinion as to the best means of incorporating Television into the Society's activities, a further meeting with the representatives of the Television Society has been sought.

Polytechnic Presentation.—It was agreed that a donation be sent towards the presentation to be made to Mr. L. J. Hibbert on his retirement from the Photographic Faculty of the Polytechnic, Regent Street, in recognition of his valuable work in the training of so many of the Film Industry's technicians.

The proceedings then terminated.

BOOK REVIEW

Books reviewed may be seen in the Society's Library.

CINE DATA BOOK, by R. H. Bomback. 286pp. Fountain Press.

One cannot help wondering why this book has not been published before. Those of us who have frequently referred to the American Cinematographer Hand Book, by Jackson Rose, know only too well that a data book intended for use in America contains much information that cannot help us over here, and omits much information that we require. R. H. Bomback has remedied this state of affairs and, in addition to the universal tables dealing with such matters as film footages and lens data, which one expects to find in a hand book of this kind, he has provided concise information on all aspects of cinematography in this country.

Among others, there are sections on High-Speed Cameras, Laboratory Work, Studio Lighting, Colour Photography, Tone Reproduction, and Exposure Control, Sound Recording, Processing Control, Modern Projectors, and Screen Brightness.

A large number of half-tone and line illustrations are provided, and the general impression one gets is that the information and the illustrations are absolutely up-to-date. The size of the book is small (approximately 7ins. x 4ins.) and this will surely mean that it will soon find its way into the pockets of all enterprising technicians in the industry.

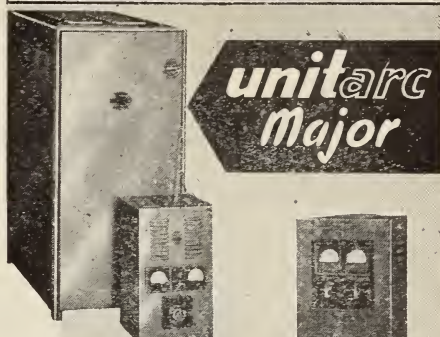
JACK H. COOTE.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

Y. A. FAZALBHOY is chairman of the newly inaugurated Radio and Electronics Society of India.

Hewittic Rectifiers



unitarc

unitarc Minor

HEWITTIC Cinema Rectifiers efficiently meet every requirement for the operation of projector arcs in cinemas, large or small; bearing a name with a world-wide reputation amongst cinema technicians—modern as the minute, exceptionally simple to install and operate, amazingly economical, compact in design, styled to match the modern projection room. Backed by well over 40 years' experience in rectifier manufacture.



Illustrated:

UNITARC Major (up to 75 amps. D.C.) with projection room remote control unit.

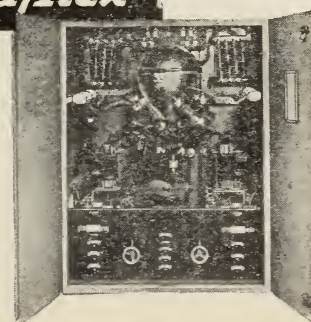
UNITARC (25 to 65 amps. D.C.).

UNITARC Minor (up to 45 amps. D.C.) for smaller halls.

Econotrol DUPLEX. Operates two projector arcs from a single bulb.

Duplex

Ask for Publication R.213

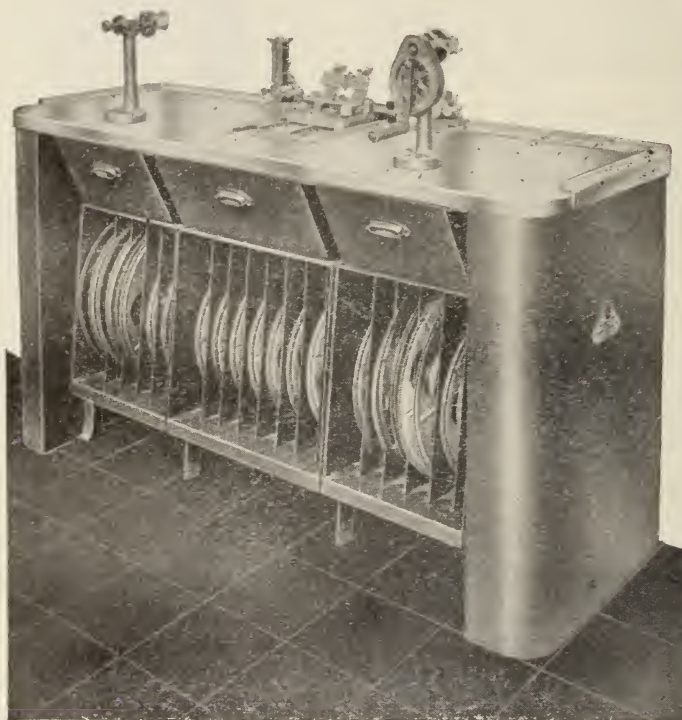


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It has, we are proud to announce, received the unanimous commendation of those responsible for the conception and presentation of the Telecinema entertainment. It consists not only of the rigidly constructed bench itself, but also of all the necessary accessories for speedy and efficient rewinding and editing of 3,000 feet spools of stereofilm.

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BRITISH KINEMATOGRAPHY

VOLUME 18, No. 6

JUNE, 1951

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PRESENTING A PAPER

THE Journal and Papers Committee is often faced with a difficulty which is known to all similar committees in the Learned Societies. Some papers submitted for presentation are, by reason of excellent demonstrations and use of visual aids, of a very high standard for presentation to an audience, but are sometimes extremely difficult to present in a convincing way in the pages of our Journal. The Committee feels that, on the contrary, many of its members could present papers for publication which may be unsuitable for an audience. Some of our members have carried out brilliant original work and others have had experiences of filming in foreign lands and in extremes of climate. These researches and experiences would prove most interesting and

instructive to other members. Some authors may feel that they cannot devote sufficient time either to prepare demonstrations or to present a paper in person.

To all such people the Committee extends an invitation to submit a paper for publication only. The preparation of blocks for photographs or diagrams is undertaken by the Society. The Committee merely asks authors for an interesting and legible script.

Editing is facilitated if copy is typewritten in double spacing.

R. J. T. BROWN,
Chairman, Papers Sub-Committee.

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Editor: R. HOWARD CRICKS, F.B.K.S., F.R.P.S.

Hon. Consulting Editor: GEOFFREY PARR, M.I.E.E., F.B.K.S.

STEREOSCOPY IN THE TELEKINEMA AND IN THE FUTURE

Leslie P. Dudley, D.F.H., A.M.I.E.E., A.R.Ae.S., F.R.S.A.*

BEFORE discussing the actual apparatus used for production and projection of the stereoscopic films being shown at the Telekinema, it will no doubt be of interest to examine briefly the considerations which resulted in the adoption of the system concerned in preference to certain alternatives.

A NEW POLYCHROMATIC ANAGLYPHIC PROCESS

Synchronous eclipse and monochromatic anaglyphic processes must be regarded as

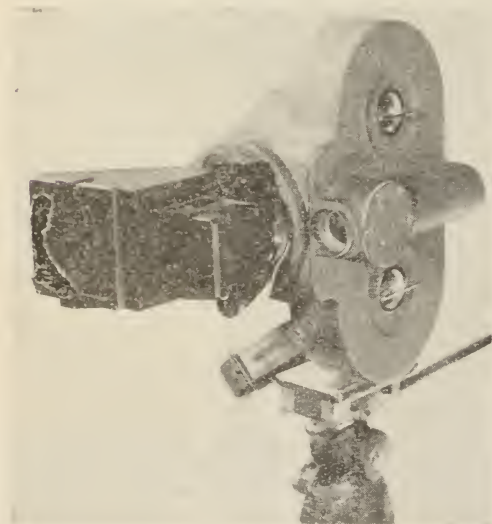


Fig. 1. Polychromatic Anaglyphic Attachment fitted to Bell and Howell Filmo.

impractical in the case of the former and obsolescent in the case of the latter.¹ Consequently, no consideration was given to processes in either of these categories. A new polychromatic anaglyphic process is available, however, which represents a considerable advance on earlier processes of similar type. It is not proposed to describe the process here, full details being available in the author's British Patent No. 634,890. The chief merit of the system lies in its extreme simplicity. The special stereo attach-

ment used is fitted externally to any camera, and standard monopack colour stock is employed. A typical attachment is shown in Fig. 1.

Processing is carried out in accordance with the normal procedure for the stock concerned. As a result, the image produced in each frame of the film is in the form of a polychromatic anaglyph occupying the full area of the frame. The projected images are seen both stereoscopically and in colour when viewed through the appropriate anaglyphic spectacles. Any existing projector, without the addition of any special filters or other devices, may be used. The colour reproduction, however, is slightly less perfect than that obtainable with the same stock exposed in the normal manner. For this reason it was decided, after consideration, not to employ the process for the Festival stereoscopic films.

AUTO-STEREOSCOPY

Stereoptics, Ltd., were also asked whether it would be possible to provide an auto-stereoscopic system, and, as was stated at the time, the provision of a system of this type would have been technically practicable. Serious consideration of the proposal was, however, out of the question owing to the short time available in which to produce the equipment and to the very considerable expenditure which would have been entailed in production of the necessary special screen and other apparatus.

The author ventures, nevertheless, to express his personal opinion that expenditure in this direction might well have proved an investment yielding a handsome dividend to the British film industry. The cost involved would, in any case, have been comparatively small when considered in relation to the sums expended on certain other Festival projects which are unlikely to result in any permanent benefit to industry.

* Technical Director, Stereoptics, Ltd.

Parallax Stereogram Principle

As far back as 1935 the author successfully demonstrated auto-stereoscopic kinematography by means of the parallax stereogram principle,² which principle was adopted several years later by Sergei Ivanov in Moscow.³

Two synchronised cameras, mounted side by side, were used for filming the scene. Thus, one of the two film records represented a "left-eye" view of the scene and the other a "right-eye" view.

The arrangement adopted for projection is shown diagrammatically in Fig. 2. Two synchronised projectors, carrying the "left-eye" and "right-eye" films respectively, are arranged at L and R. The projector

his left eye only the "left-eye" strips, and with his right eye only the "right-eye" strips. Hence, each sees the projected scene in stereoscopic relief. In practice there are many laterally spaced positions, such as A, B and C, from which a parallax stereogram can be seen in stereoscopic relief, and the stereoscopic viewing zones extend back for a considerable distance from the screen. Unfortunately, as will be evident from examination of Fig. 2, these zones are inevitably interleaved between pseudoscopic viewing zones of the same width.

Grid Aperture Ratio

In Fig. 2, again for the sake of clarity, the opaque and transparent strips of the viewing

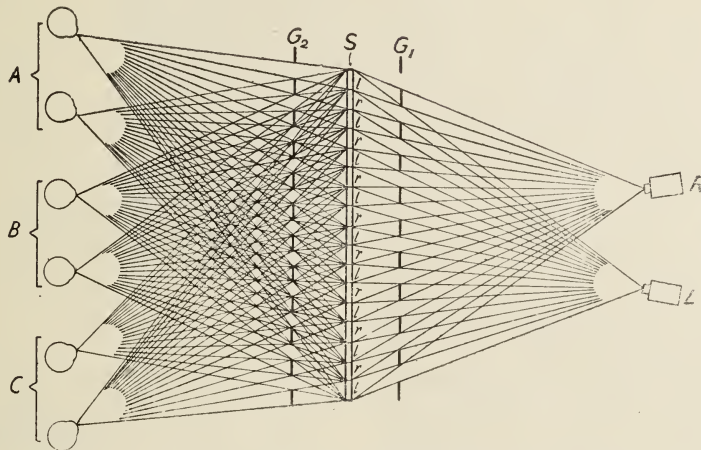


Fig. 2. Projection of Parallax Stereograms with Two Projectors.

beams pass through the transparent gaps in a line grid G_1 to form images on a translucent screen S. The relative positions of L, R, G_1 and S are so chosen that the images on the screen are in the form of alternate "left-eye" and "right-eye" vertical strips as denoted by l, r, l, \dots etc.; that is to say, the picture is in the form of a parallax stereogram. The spectators view the screen through a second, suitably positioned grid G_2 . For the sake of clarity in the drawing, the positions of only three spectators, A, B and C, have been shown.

It will be observed that, owing to the presence of the grid G_2 , each spectator sees with

grid are represented as being of equal width, whereas it is customary for the transparent strips to be made somewhat narrower than the opaque ones. The reason for this can be seen from Fig. 3. Referring first to Fig. 3a, L represents the left eye of an observer viewing a "left-eye" element l of a parallax stereogram through a gap in a grid G having a 1/1 opaque/transparent ratio. Portions of the "right-eye" elements adjacent the "left-eye" element l are denoted by r_1 and r_2 . Clearly, the slightest lateral movement of the observer's head will cause him to see a double image. Thus, if the observer moves his head to the left, his left eye will see a

portion of r_2 in addition to a portion of l . If he moves his head to the right, his left eye will see portions of both r_1 and l .

Referring, now, to Fig. 3*b*, in this case the opaque/transparent ratio of the grid has been increased to approximately 2/1. As a result, the observer has now been accorded some degree of freedom of movement. He can move his head leftwards so far that his left eye L reaches the position L_1 , or rightwards so far that his left eye reaches the position L_2 , without seeing a double image.

Whilst increasing the grid ratio has the desired effect of increasing the width of the orthoscopic viewing zones, thereby providing some freedom of movement within each such zone, the same increase in width is imparted to each intermediate pseudoscopic viewing zone. This means that if a kinema be equipped for the projection of simple parallax stereograms, the seating capacity of the auditorium is inevitably reduced to rather less than 50 per cent. of the normal. It has been found in practice that the grid ratio should be 3/1 or more, and this naturally entails a serious reduction in the amount of light transmitted. This difficulty can be overcome by the use of cylindrically lenticulated grids, for such grids are optically equivalent to line grids of high ratio, with the advantage of good light-transmitting properties. Moreover, with a suitable lenticular grid, front projection becomes a practical proposition, the pictures being projected and viewed through the same grid.

Parallax Stereograms with Single Projector

In 1939, British Patent No. 514,624 was granted the author, the specification covering the construction of a stereoscopic camera suitable for recording parallax stereogram images direct on kinematograph film. The use of such an instrument results in several advantages. As only a single camera and single projector are required, there are no synchronisation problems. Further, as the image on the film itself is in the form of a parallax stereogram, the grid G_1 in Fig. 2 is no longer necessary. Hence, the projection arrangement is simplified to that shown in Fig. 4.

Some preliminary work was done in connection with this modified arrangement, but the project was abandoned owing to the outbreak of war. The author did not, moreover, subsequently resume work in this direction owing to his conviction that the disadvantages of the parallax stereogram, discussed briefly above, render this type of auto-stereoscopic picture unsuitable for general adoption in the kinema. It is, nevertheless, of interest to note that an auto-stereoscopic system, at least as satisfactory as that now in use in Russia, was available in his country no less than sixteen years ago.

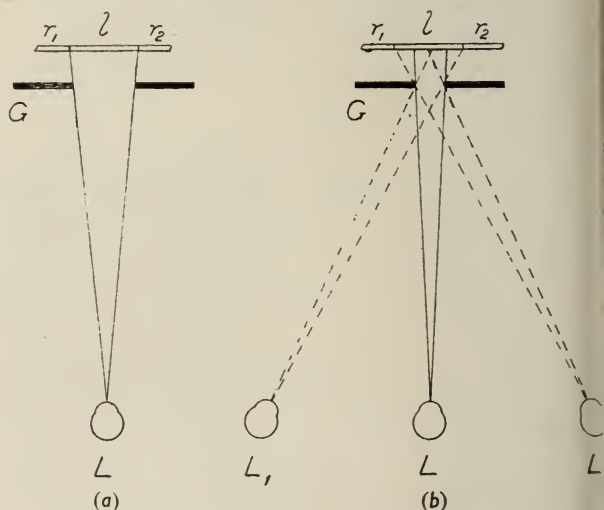


Fig. 3. Effect of a Varying Parallax Stereogram Grid Ratio.

Parallax Panoramagram Principle

Towards the end of the war, when it became possible for the author to resume research into auto-stereoscopic film processes, his attention was devoted first to the possibility of utilising the principle of the parallax panoramagram. His investigations left him with little doubt that it would be possible to develop a kinematograph system embodying this principle which would be satisfactory from the point of view of the kinema patron. Film technicians and exhibitors, on the other hand, might take a different view, as research tends to indicate that the necessary photographic and projection equipment would almost inevitably be both cumbersome and complex.

In view of these considerations, therefore, the author commenced an investigation into the possibility of developing a new type of auto-stereoscopic photograph which would be capable of meeting the following requirements:

First, as in the case of the parallax stereogram, the constitution of the image to be such that all parts can be recorded simultaneously, thus obviating any "time parallax" when such images are produced kinematographically;

Secondly, as in the case of the parallax panoramagram, the orthoscopic viewing zones to be much wider than the pseudoscopic viewing zones.

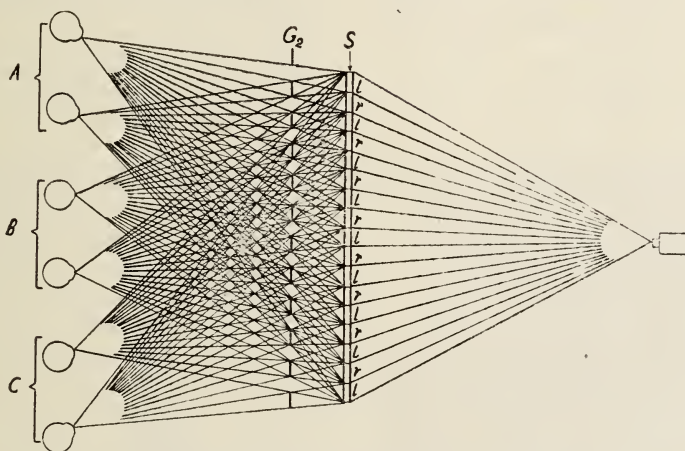


Fig. 4. Projection of Parallax Stereograms with Single Projector.

By the end of 1946 it was found possible to lay down a precise specification for a photograph possessing the above characteristics. Early in 1947, however, work on auto-stereoscopic films had, once again, to be postponed in order that attention could be given to the development of certain stereoscopic processes to meet existing demands in advertising and other fields. Work on the auto-stereoscopic film project was again resumed, at a low priority, about two years ago, and it can now be stated that, for some time past, production of the necessary type of photographic image has been an accomplished fact. The author is unable, at the present time, to disclose full details of the process, but a few brief particulars will no doubt be of interest.

Panoramic Parallax Stereogram

The new type of photograph, known as

the *panoramic parallax stereogram*, consists of a number of vertical picture elements which are viewed through a lenticular or line grid. Each pitch-distance of the image, unlike the parallax stereogram, does not contain a pair of homologous elements. The arrangement is such that each pitch-distance contains a view of a particular element of the scene, the aspect portrayed ranging from extreme "leftwards" at the right-hand edge to extreme "rightwards" at the left-hand edge. The disparity in aspect represented by these two extremes corresponds to a stereo-

scopic base of considerable magnitude. In this respect, therefore, the image construction may be said to resemble that of the parallax panoramagram.

In the sketch, Fig. 5, P represents, to a greatly exaggerated scale, an element of a panoramic parallax stereogram being viewed through a single lenticulation of a grid G. The observer's left and right eyes respectively are denoted by L and R. The aspects represented by the element, the width of which is D , vary from extreme "rightwards" at R' to extreme "leftwards" at L'. Now, the points r' and l' on the element which are visible to respectively the right and left eyes of the observer, are separated by a much smaller distance d . Further, matters are so arranged that, from the average viewing distance, the value of d approximates to $\frac{DE}{S}$ where E is the normal interocular dis-

tance, and S the effective stereoscopic base of the photographic apparatus, all dimensions being in the same units. As a result, the disparity between the aspects presented by the points r' and l' is appropriate for the production of correct stereoscopic relief.

It can readily be shown that with a system of the type under discussion the orthoscopic viewing zones are approximately $(\frac{S}{E} - 1)$ times as wide as the pseudoscopic viewing zones. For kinematographic purposes a convenient value for S is in the neighbourhood of 20 ins., this resulting, as will be evident, in an orthoscopic/pseudoscopic ratio

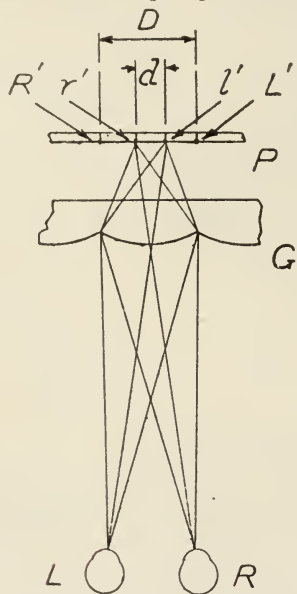


Fig. 5. Viewing Panoramic Parallax Stereogram.

of about 7/1, which may be regarded as a satisfactory value.

That the motion picture industry will eventually change over to auto-stereoscopy is beyond doubt, although, naturally, it is impossible to predict the precise nature of the various evolutionary stages through which it will pass. It seems, nevertheless, reasonable to believe that a system based on the principle of the panoramic parallax stereogram, preferably allied to a four-track stereophonic system such as that now in use at the Telekinema, would meet the industry's requirements for a good many years.

POLARIZED LIGHT PROCESSES

Some years ago a convenient single-film polarized light process was evolved by Zeiss-Ikon, but those familiar with the process will be aware that it suffers from the disadvantage of involving a serious reduction in the illumination available from the projector. More than half of this loss of light is due to the fact that the bi-prism used for producing superimposition of the two components of the stereogram is arranged in close proximity to the projection lens. As a result of this arrangement, but for the use of two pairs of polarizing filters (one pair in the film gate and the other pair close to the bi-prism), there would be two pairs of images, of substantially equal brightness, at the screen surface. One pair of filters is required for polarization of the superimposed stereoscopic pair of images, and the other pair of filters is required for suppression of the two unwanted images which would otherwise be visible, one at each side of the superimposed pair.

During the past few years the author has developed a single-film system which can be regarded as a considerable advance as, for an illuminant of the same output, the screen brightness is approximately $2\frac{1}{2}$ times that available with the Zeiss-Ikon system. Moreover, the system is immediately applicable to any existing projector, without alteration, as the single pair of polarizing filters used is incorporated, together with the image-converging device, in one unit arranged in front of the lens.

A new single-film Polarized Light Process

The principle underlying the process, which is the subject of various British and foreign patents, may be described briefly as follows. Considering one-half of the field of, say, a projection lens, it is readily demonstrable that, at the plane of the lens, the image-forming rays consist of rays from both halves of the object field in equal proportions. This condition may be referred to as that of zero segregation. At the other extreme, that is to say, at the image plane, the image-forming rays in any half of the image field consist entirely of rays emanating from

the appropriate part of the object field. This condition may be referred to as that of total segregation. It can be shown further that, between these two extreme positions, segregation varies from zero to total (infinity) according to a function:

$$f\left(\frac{d \tan \frac{\theta}{2}}{a}\right)$$

where d denotes the distance from the lens, a the maximum effective aperture (measured in the same units as d) of the lens, and θ the angular field of the lens.

We are concerned with determining the minimum value of d at which segregation will be sufficiently far advanced for the pur-

result for any stereoscopic purpose. This value is given by:

$$d = \frac{a}{\tan \frac{\theta}{2}} \dots \dots \dots (1)$$

at which distance there is still serious overlapping across approximately the "middle third" of the cross-section of the lens field.

By introducing a constant k into equation (1) we obtain a satisfactory formula for design purposes, thus:

$$d = \frac{ka}{\tan \frac{\theta}{2}} \dots \dots \dots (2)$$

Empirical methods have shown that a value of k in the region of 2 is satisfactory

Fig. 6. Arrangement of Images for Projection by Single Film Polarized Light System.

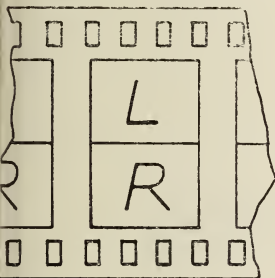
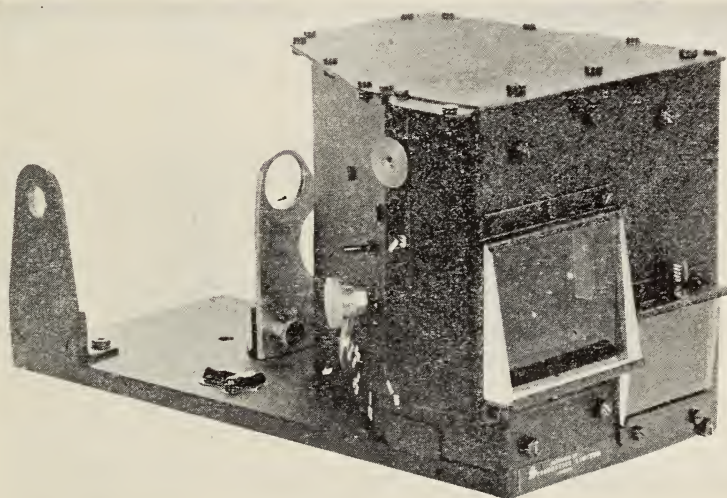


Fig. 7. Stereoscopic Camera Attachment for Single Film Polarized Light Process.



pose in view, that is, the minimum distance from the lens at which we may position the converging and polarizing unit. When it is desired to segregate, to their appropriate halves of the lens field, the two images of a stereoscopic pair, it is not possible to specify precisely a minimum value for d which will give an acceptable result, because the minimum value is inevitably governed to some extent by the amount of image overlap which can be regarded as tolerable in a particular case. It is, on the other hand, a simple matter to specify a definite, sufficiently small value for d which will yield an intolerable

for most purposes. (Values of k adopted by Stereoptics, Ltd., range from 1.7 up to 4.0 according to the precise nature and purpose of the apparatus concerned.)

Application of New Process

In producing kinematograph films for projection in accordance with the principle outlined above, the author prefers the arrangement of images shown in Fig. 6. The "left-eye" and "right-eye" views, denoted in the sketch by respectively L and R, are recorded side by side, but each image is rotated in the same direction through an angle of 90° ,

In this way the stereoscopic pair, each component of which is of the same proportions as a standard motion picture frame, is caused to occupy practically the whole area of the frame. Filming in accordance with this method can be carried out with any existing camera, without alteration, the necessary stereoscopic optical system being attached externally.

Serious consideration was given to the possibility of employing this process for the Festival of Britain stereoscopic films. It seems likely that the process would have been adopted but for the fact that, at the

polarizing unit. For stereoscopic projection the projector is placed on the baseboard with its lens immediately behind the erecting prism, that is, to the right of the prism as viewed in the photograph. The beam then passes, first through the erecting prism, and then through the converging and polarizing unit.

Of the many polarized light processes with which the author has had experience, including those which he himself has developed, that described above is, in his opinion, by far the most satisfactory. The ease with which the system can be put into operation

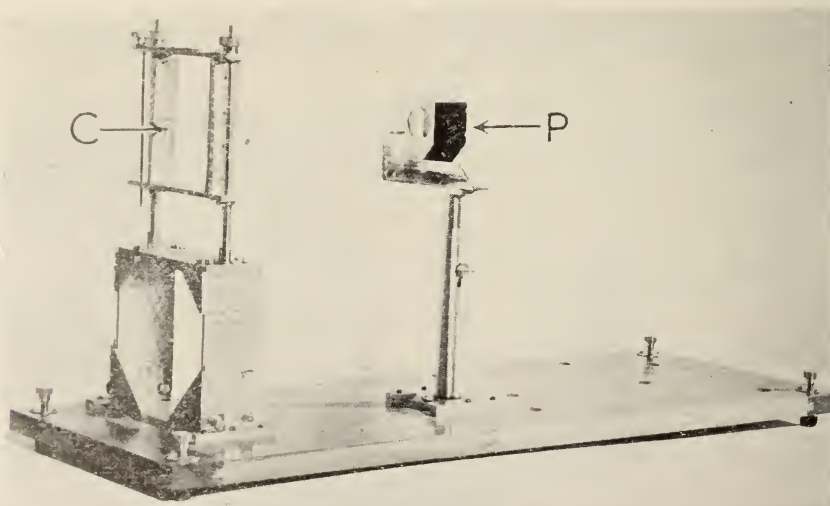


Fig. 8. Stereoscopic Projection Apparatus for Single Film Polarized Light Process.

time the Festival authorities wished to place the contract for supply of the apparatus, no camera attachment incorporating the image-rotating feature was available for demonstration.

Examples of apparatus embodying the foregoing principles, recently supplied by Stereoptics, Ltd., to one of the Government research establishments, are shown in the photographs Figs. 7 and 8. The camera attachment is illustrated in Fig. 7, and the auxiliary optical apparatus for use with the projector is shown in Fig. 8. The actual apparatus illustrated was designed for use with 16 mm. equipment.

Referring to Fig. 8, P denotes a 90° erecting prism, and C the converging and

with any existing camera and projector is a point which should commend it to the motion picture industry in the event of a decision to exploit the polarized light principle for a time, pending the eventual change to auto-stereoscopy.

Picture Definition

It seems opportune here to correct an erroneous belief, held in some quarters, concerning the picture definition available with systems of this type. Some who are not fully conversant with such systems are under the impression that if, for example, the area of a 35 mm. frame be arranged to contain the two components of a stereogram, each component occupying one-half of the area, the available

definition with the two components fused binocularly will be only 50 per cent. of that obtainable with a single, planoscopic picture occupying the whole frame.

This is a topic which the author has had cause to examine with some thoroughness, and it is to be emphasized that if the two components of the stereogram be projected and viewed as a three-dimensional image of given size, then the definition will be almost precisely equal to that of the image of the planoscopic picture projected the same size. The word *almost* is used because there will be a very small, imperceptible reduction in definition attributable to the stereoscopic image, which reduction varies inversely as the total area of emulsion occupied by the component pictures, and directly in accordance with a very complex function of the number (two in the present case) of such pictures. The complexity of the direct function is due in part to the fact that the homologous views with which we are concerned in stereoscopy are not precisely the same except when the object is at infinity, the dissimilarity increasing with decreasing distance of the object.

For all practical purposes, however, the definition available with a simple stereogram can be taken as dependent on the combined area of the two views—not on the area of a single component.

An interesting series of tests was carried out some time ago to determine the number of identical pictures which could be recorded satisfactorily in a single 35 mm. frame, these images being projected in accurate superimposition. The superimposed images were compared with a single image, projected to the same dimensions, of the same subject photographed full-frame size. For reasons which need not concern us here, these comparative tests were made with frames so divided that the number of pictures was successively 2, 2², 2³, 2⁴ . . . and so on. It was found that even with 2⁶ (i.e. sixty-four) pictures per frame the reduction in definition was surprisingly small.

Telekinema Two-film System

As we have seen, for one reason or another decisions were taken against adopting for the

Festival of Britain Telekinema stereoscopic films any of the processes so far discussed. There remained, therefore, no alternative other than to employ, in the most effective manner possible, the well-known polarized light process involving the use of two cameras and two projectors. It is not without interest to note that this method was proposed as long ago as 1890 by Anderton, but the development of a practical process was delayed for nearly half a century by the high cost of natural polarizing crystals and the difficulty of obtaining them in sufficiently large sizes. E. H. Land, in 1934, went a long way towards overcoming these obstacles by his invention of the synthetic polarizing material which, of course, we know as Polaroid.

The Festival of Britain, when placing the contract with Stereoptics, Ltd., for supply of the necessary stereo photographic apparatus, laid down a rigid specification as to not only the precision with which the equipment must be manufactured, but also the functional characteristics of the apparatus. The more important of the functional requirements are listed below:

- (1) The complete apparatus, including two Newman Sinclair Model G Auto Kine cameras¹ provided for the purpose, to be sufficiently light to be supported by a single Vinten tripod.
- (2) The apparatus to be suitable for use with matched pairs of Cooke lenses ranging in focal length from 28 mm. to 100 mm.
- (3) The effective stereoscopic base of the apparatus to be adjustable from a maximum value of not less than about 8 ins. down to a minimum value rather less than the normal interocular distance.
- (4) The angle of convergence of the optical system to be adjustable independently of the stereoscopic base.
- (5) The camera mechanisms to be operated synchronously.
- (6) Focusing of each pair of lenses to be coupled and synchronized, so that adjustment of the focus of either one of a pair of lenses produces a corresponding adjustment of the focus of the other.

Stereoscopic Camera Equipment

The apparatus developed in order to meet the above requirements is illustrated in the photographs Figs. 9 and 10, which show respectively front and rear views of the equipment. The principle involved, which is the

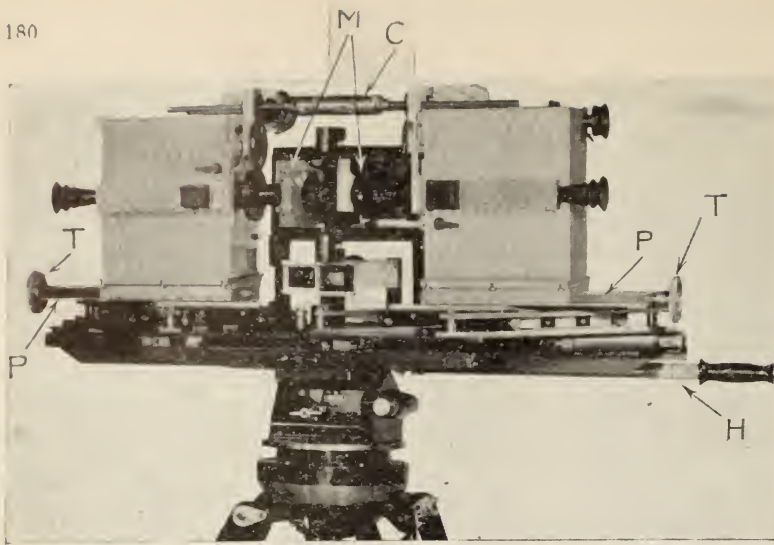


Fig. 9. Two-film Stereo Photographic Apparatus—Front View.

subject of the author's Provisional Patent No. 17,086/50, is shown diagrammatically in the sketches Figs. 11 and 12.

Referring first to Fig. 11, L and R denote the two cameras, the former being employed for recording the "left-eye" view and the latter the "right-eye" view. Light rays, such as the axial ray l from the subject reach the camera L after reflection through an angle of 90° by a front-aluminized mirror M_1 . Likewise, light rays, such as the axial ray r , reach the camera R after reflection from a similar mirror M_2 . In this diagram the apparatus is represented as being adjusted for filming a very distant subject. Accordingly, matters are so arranged that the stereoscopic base D is of comparatively large value, and the axial rays l and r are substantially parallel, the latter condition being secured by adjustment of the angle ϕ between the mirrors to a figure approaching its minimum value of 90° .

In Fig. 12 the apparatus is represented as having been adjusted for filming the sub-

ject from a reduced distance. Such adjustment is effected by two main operations: (1) The two cameras are moved in the directions indicated by the arrows to new positions so that the stereoscopic base D is reduced to an appropriate value. (2) The angle ϕ between the mirrors is increased so that the rays l and r still originate in some common pre-selected point p in the field of view.

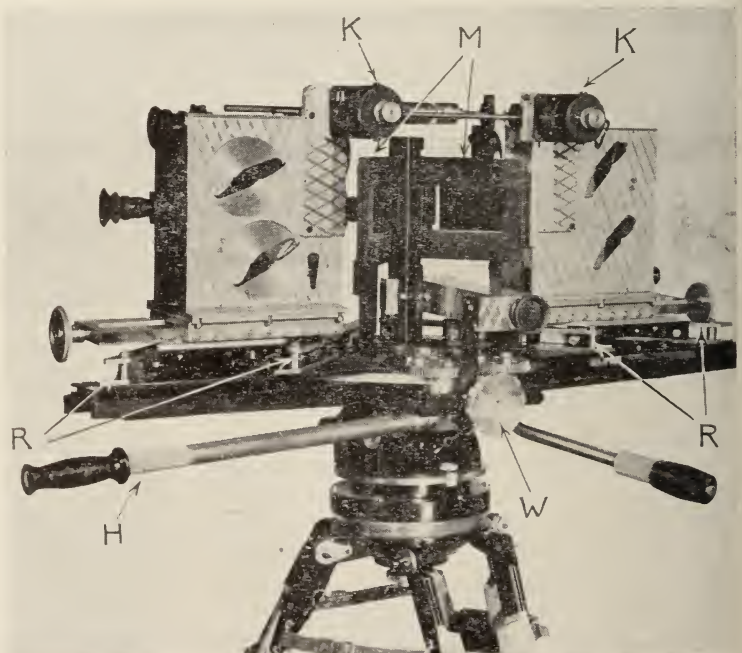


Fig. 10. Two-film Stereo Photographic Apparatus. Rear View.

Figs. 11 and 12 are, it is considered, adequate to illustrate the general principle of operation, although it should be noted that it is possible to adopt any combination of D and ϕ within the limits laid down in the specification. It is one of the mechanical features of the stereoscopic mounting that the angle α between the optical axis of each camera and its associated mirror is maintained constant and equal to 45° for all settings of the apparatus.

Adjustment of the stereoscopic base D is effected by forward or backward movement of the lever H in the photographs Figs. 9 and 10. Movement of this lever causes the cameras to move in the required direction, parallel to the surfaces of the mirrors K ,

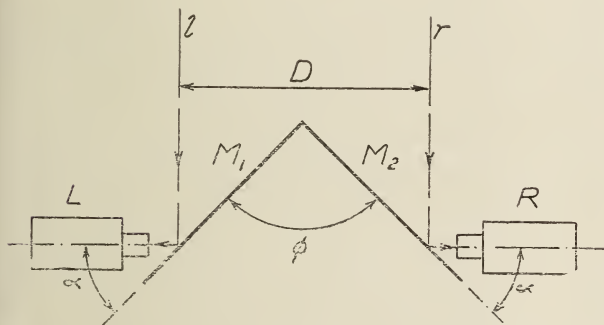


Fig. 11. Two-film Stereoscopic Apparatus Set for Distant Shots.

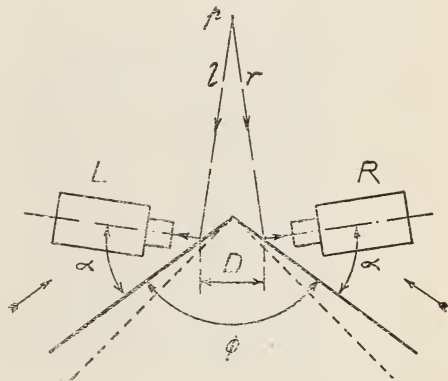


Fig. 12. Two-film Stereoscopic Apparatus Set for Close-up.

along the rails indicated in Fig. 10 by R. The angle of convergence is adjusted by turning the handwheel W which can be seen in the same photograph. Two further small handwheels are provided, and are indicated by T in Fig. 9. Rotation of these two handwheels produces movement of the cameras along the platforms P . In this way it is possible to adjust the positions of the cameras so that the lens fronts are always in close proximity to the mirrors, whatever the focal length of the particular lenses in use. As can be seen in Fig. 9, the focusing rings of the two lenses

are interconnected via gears and the universally-jointed coupling C .

The camera mechanisms are driven synchronously by two 12-volt electric motors, shown at K in Fig. 10, coupled by a flexible shaft. Since the present photographs were taken, however, the motors have been re-mounted nearer the camera bases in order to eliminate trouble due to vibration which occurred with the motors mounted as shown.

Some of the material in the present article is based on data from the author's book, "Stereoptics." He wishes, therefore, to thank Messrs. Macdonald & Co. (Publishers), Ltd., for permitting this material to be reproduced here.

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SERVICE TEST FILMS FOR 16mm. PROJECTORS

M. V. Hoare, B.Sc., F.I.B.P. (Fellow)*

Read to the B.K.S. 16mm. Film Division on January 10, 1951

THE fact that 16 mm. film is now used mainly as a professional or semi-professional medium has led users to demand from it a standard comparable to that currently achieved on 35 mm. film. Naturally, the smaller size and lower surface speed make the engineering problems involved in achieving and maintaining this standard considerably more severe than is the case in 35 mm. film. To get the best attainable results from the film, the laboratory work must be of the highest order and the projection equipment be manufactured and maintained to closer limits than are demanded in 35 mm. practice. An additional handicap lies in the fact that this branch of the industry has developed from a mainly amateur background, so that much of the equipment in the past and even to-day is made at a low price, at the cost of a shoddiness of materials and design which cannot be tolerated in professional equipment.

The 16 mm. film user still normally requires a portable projector on which shows are given either as required in a hall mainly intended for other uses, or in a variety of places as the projector is moved about. Thus, the projector must be light and compact for ease in transit. Equipment for 35 mm. is normally serviced by skilled men on a contract basis at regular and frequent intervals; 16 mm. equipment, for the most part, must be serviced by the user, although the limits to which it must be adjusted are finer. Naturally, the user cannot have at his disposal the relatively elaborate tools of the regular serviceman, and the service test film represents an attempt to provide, relatively cheaply, tools which will enable the user to maintain his projector efficiently, and to detect even gradual deterioration before it becomes serious. It will also assist in getting the best speaker placings and tone control settings to suit the needs of a strange auditorium.

American Usage

In the United States the use of test films has long been general practice,¹ and the Motion Picture Research Council and the Society of Motion Picture and Television Engineers have issued stringent specifications for a large series of laboratory test films.² These specifications are very severe, as the films are intended for the testing of equipment in manufacture and in processing. The films are most difficult to manufacture and are consequently expensive. Despite various attempts to rectify the position, these films have been available in this country only to a limited extent, and, it is believed, have always been imported from the United States. Thus, test films have not in the past been at all widely used in this country.

It is with particular pleasure, therefore, that the present group of test films is brought to the attention of 16 mm. film users. These films are described as "Service Test Films" and are intended for the actual user who wishes to get the best at all times from his projector. They are prepared in this country to a specification which is in some respects less severe than the American counterpart and thus they can be sold at a relatively low price. It must be realised, however, that great care is required in the preparation of any test film, therefore the price must always be considerably in excess of a similar footage of release prints.

There are in all nine films, six for sound and three for picture.

Sound Test Films

1. *Sound Focus and Azimuth Test*.—This film consists of a square wave recording of a 5,000 c/s note. It is used, as its name implies, for adjusting the focus of the sound optical system and the azimuth of the slit. This is an adjustment which can, perhaps, be done in no other way, and is obviously of the greatest importance if good "top" is to

* Kay Film Printing Co.; Ltd.

be reproduced. As the total length of track occupied by one cycle of a 5,000 c/s note is just under 1.5 mils, clearly these adjustments must be made with the greatest accuracy.

A complication is introduced by the fact that any prints made by the negative-positive process will have to be projected with the emulsion in a non-standard position, i.e. emulsion towards the lamp. Thus, if the optics are correctly focused for standard prints they are wrong for non-standard, and *vice versa*. On some projectors provision is made for shifting the focus by the required amount easily and accurately, *e.g.*, by introducing a parallel-sided glass slab of the appropriate thickness into the optical system, but others rely on normal re-focusing, whereas yet others have no provision for re-focusing and rely on a pre-set focus for an intermediate position. The same test film, by running from head or tail, can be used for either standard or non-standard position.

In use the azimuth is first adjusted (if this adjustment is provided) to give maximum volume. Volume is preferably read with a volume indicator across the speaker terminals, but may be judged by ear. Then the focus is adjusted to give maximum volume and tightened up. It is important to tighten the adjustment before the final test, as it is fairly common for the focus to shift on tightening. This test should be carried out whenever the projector has been transported, otherwise at frequent intervals, as a shift in focus often occurs and is not easily detected. To save slacking off and re-tightening the focusing adjustment each time, it is advisable to observe the reading of the output meter at a definite volume and tone control setting, and use this as a standard, a normal reading indicating that all is well. If the reading is down, voltage to the amplifier should be checked and corrected, if necessary, before re-focusing.

2. Sound Flutter Test.—This consists of an 80% modulated variable area track of a 500 c/s tone. It serves to render low frequency flutter or "wow" very easily audible. As it is a pure note, its quality also serves to indicate the evenness of illumination on the slit. Any harmonics introduced

will indicate uneven illumination, due either to the lamp being out of position or to dirt in the slit. An error in the position of the slit itself is detected by another film specially designed for the purpose.

3. Sound Flutter Test.—This consists of an 80% modulated variable area track of a 3,000 c/s note. It serves to show up high frequency flutter due to poor filtering or incorrect loop size. High frequency flutter, resulting in harsh speech, is introduced rather easily in printing in the laboratory, but it is particularly important to check on the projector before complaining of defective printing.

4. Sound Frequency Test.—This is modelled on the familiar gliding tone, but is

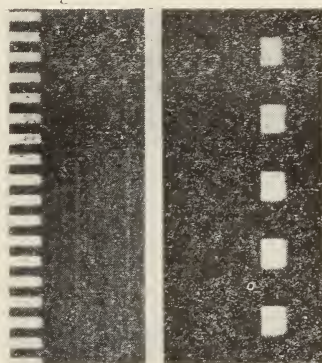


Fig. 1. Buzz-track for checking Sound Track Alignment.

unusual in pausing on 10 selected frequencies for 10 seconds each. The gliding tone is particularly well adapted to detecting resonances or irregularities in the output of the amplifier or speaker and there is sufficient time to make measurements at each of the selected frequencies of 50, 100, 250, 500, 1,000, 3,000, 4,000 and 6,000 c/s.

Flutter can also be detected with this film, and the output at the higher frequencies indicates if the optics need adjustment.

5. Sound Track Alignment Test (Buzz Track).—This is a most important test film as it is a common projector error to scan the wrong portion of the film. This is difficult or impossible to detect by other means. In the laboratory any defects or marks outside the scanned area will be ignored, and the

scanning of the wrong area, in addition to introducing distortion on variable area tracks, may also pick up hums due to the sprocket hole modulation from 35 mm. sound negatives and other undesired noises.

The track area is opaque, so that on a correctly adjusted projector nothing is heard at all. Down the outside edge of the film is a square wave of 1,000 c/s, whilst between picture and track is a 300 c/s square wave as illustrated. Thus, if the scanning area is out of position a note is heard whose pitch at once indicates the direction. On some projectors in which the scanned area is above standard width both notes are heard at once. As they are not harmonics of each other they are easily detected. On a projector suffering from weave the notes will be heard in succession. As most projectors take some

of a central target and four other targets near the four corners. If the central target is sharply focused, lack of covering power of the projector lens or out of truth of the gate or tilt of the lens axis is easily detected. The five patterns should, of course, all be equally sharp together. The use of this film when setting up for a show will avoid the necessity of focusing on the titles as the picture commences, thus helping towards good showmanship.

2. *Picture Steadiness Test.*—Unsteadiness is one of the most frequent complaints on 16 mm. film. The question always arises as to whether the unsteadiness is in the copy or in the projector—or even occasionally in the original—or how much each has contributed to the final result. Every projectionist will welcome a piece of film of known steadiness.



Fig. 2. Three Picture Test Films.

Blocks by courtesy of "Film Use."

appreciable time to settle down it is important that the film be allowed to run for at least 10 seconds before any conclusions are drawn.

6. *Sound Balance Test.*—This film consists of a recording of various types of music and speech and is intended primarily for adjusting speaker position and tone controls to get the best result in an unknown auditorium. It serves as a good general check of the condition of equipment and on the quality of sound that can be expected from it.

Picture Test Films

As the eye is normally more sensitive than the ear, picture quality is more easily judged than sound and the faults more easily diagnosed. However, the test films will be found to solve immediately the question as to whether the projector or the copy is at fault where poor picture quality is suspected.

1. *Picture Focus Test.*—This film consists

The actual picture is a pattern of vertical and horizontal lines spaced apart by 2% of the picture height, so that unsteadiness can easily be estimated to within $\frac{1}{2}\%$ of the picture height.

3. *Picture Travel Ghost Test.*—Where the shutter is not integral with the intermittent motion shaft, ghosting may occur due to a shift in the shutter phasing and remain undetected for a considerable period if it is slight, with a consequent loss of definition. This test pattern of diamonds on a black background makes any trace of ghosting easily seen; it can, therefore, be corrected.

It will be seen that this series of test films enables the user with only the simplest of other test equipment, or even none at all, to check his equipment and adjust it to give the best performances at all times. Their use generally should serve to raise the standard of projection and to avoid the unfortunate "buck passing" which has so often delayed

progress in this field. The projectionist who uses these films is in a position of knowing what his equipment is doing, instead of hoping that the deficiencies in his show were due to the poor quality of the copies with which he is supplied.

The author's thanks are due to Mr. J. S. Abbott and his staff, of the Gaumont British Picture Corporation, Film House, Wardour Street, for the trouble taken in arranging the demonstration; to Mr. H. S. Hind and to

Mr. Norman Leever for providing the copies of the test films and much useful information concerning them.

During the paper, the test films were projected on a normal, well adjusted, projector and also on one deliberately put out of adjustment.

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2. A.S.A. Z.22.42, 43, 44, 45, 57, 79, 80, 81.

DISCUSSION

A MEMBER: Have there been made any test films for measuring screen illumination?

THE AUTHOR: As far as I know the answer is no. An exposure meter or a photometer does the job probably more efficiently.

Mr. W. S. BLAND: In the low frequency test it seemed not wow that you were getting so much as amplitude modulation. With regard to the buzz track, there seemed a definite zone of silence between the outside of the track area and the inside, which means that your slit can still be under size when you have that period of silence.

THE AUTHOR: I should say that what you were hearing on the 500 c/s note was almost certainly partly amplitude distortion, because we were deliberately altering the projector adjustments to try to produce a wow.

As to your second point, the black space be-

tween your square top waves is designed to be exactly the right track width; if your slit is under width you will get, of course, complete silence. The only way to test this completely is deliberately to print a track with weave on it.

A VISITOR: I should like Mr. Hoare's views on the order in which these tests should be made on the projector.

THE AUTHOR: I feel that you start with the focus and azimuth. My inclination would be to follow that with the buzz track, in order to make sure that my track position is right. After that, I should check for flutter with both flutter films. Having made sure that you are in focus, in the right position, and free from flutter, then you want to check frequency response. Is it balanced? Then your general test reel.

THE LIBRARY AND THE THEATRE DIVISION

How often have you been faced with a problem, the solution to which has eventually been found by reference to a technical work on the subject? All of us have had this experience and have realised that our collection of books is woefully insufficient to meet all the demands made upon it.

The B.K.S. Library exists so that you can find the answer to your questions without having to pay out hard-earned guineas for a book you may only look through once or twice.

If some advice on fire risks and their protection is needed, the library has a book on the subject. "Common Features of Fire Hazard," by Williamson. Perhaps you are interested in maintaining an even temperature in some particularly difficult theatre. Then have a look at "Temperature Control," by Anstey.

Someone has claimed that the "— Picture House" badly needs acoustical treatment: the powers that be demand the matter be investigated. One man says "do this," the other "do that." Who is right? A look at the "Practical Application of Acoustic Principles," by Cullum, should help you to arrive at your decision. In the operating box you are bothered with a lens diffi-

culty: "Optics," by Arthur Cox, should be consulted.

On projection generally there is a large selection to choose from: "The Complete Projectionist," by R. Howard Cricks; "Bluebook of Projection," by F. H. Richardson; "Motion Pictures with Sound," by J. P. Cameron; and "Sound Film Projection," by Campbell, Law, Morris and Sinclair, to name only a few.

If some general information on theatres is needed have a look at "The Motion Picture Theatre—Planning and Upkeep," issued by the S.M.P. & T.E. It covers drive-in theatres, lighting, television, etc., and must surely give you some ideas.

There is even a book on paint and colour mixing for the man who wants to decorate his theatre.

If technical knowledge is not required, you can read "The Cinema To-day," by Spencer and Waley; "Magic Shadows," by Quigley, etc. These publications may very easily give someone a lead for the "Better Business" campaign.

Whatever your needs, please use the Library.

H. W. PRESTON,

Member, Library Committee.

AN ANALYSIS OF THE CINEMATOGRAPH REGULATIONS, 1950. No. 2133

H. Lambert (Member)*

ON the first day of January, 1910, the legislative foundation stone of the British cinematograph industry was laid in the shape of the Cinematograph Act, 1909. This Act, which regularised the exhibition of cinematograph films by requiring all kinemas to be licensed, was initiated by pioneer exhibitors who recommended such control in the interests of public safety.

The first part of the Act requires that a kinema showing inflammable films must comply with any relevant regulations made by the Secretary of State. Such regulations were made in 1910 and 1913 but were later replaced in 1923 by new regulations which contained comprehensive requirements relating to seating, exits, staff, electrical installations, etc., all being designed towards safety in kinemas.

In 1927 the Regulations were examined with a view to bringing them up to date but due to the war the revision was held in abeyance. After the cessation of hostilities the work was recommenced and a draft of the proposed new Cinematograph Regulations was completed.

Almost coincident with the completion of this draft the cinematograph industry announced that a safety film had been developed which from extensive practical tests proved that in physical and other characteristics it was equal to the highly inflammable cellulose nitrate base. Indeed, so successful had these tests been that the industry expressed its intention to manufacture exclusively safety film as soon as practicable. This announcement naturally affected the issue of the draft Regulations which contained many requirements based upon the continued use of inflammable film. After consideration of these new circumstances the decision was taken initially to publish only the electrical section of the draft Regulations and to shelve the remainder for a period

pending the progress made in the introduction of the new safety base.

Thus in February of this year the Cinematograph Regulations, 1950, No. 2133, were published containing requirements relating to electrical installations in kinemas. Notwithstanding the fact that the new Regulations contain little legal verbiage, the purpose of these notes is to summarise, to enlarge upon and to point out some of the more important considerations involved having particular regard to the problems which face the exhibitor who is required to comply with them.

REGULATION 1

Defines some of the more important terms.

REGULATION 2

States that the new Regulations come into force on February 1, 1951, but where existing premises and equipment comply with certain of the more important electrical requirements of the 1923 Regulations the new Regulations will not be enforced until 1953. It thus gives exhibitors two years in which to make any necessary alterations. If, however, during these two years the premises are substantially altered or re-wired, it will be necessary then to comply with the new Regulations and in the case of any partial re-wiring or re-equipping it will be necessary for such sections of the installation also to comply with relevant requirements contained in the new Regulations.

REGULATION 3

Requires holes through which underground service cables and pipe work pass from the exterior to the interior of the building to be sealed so as to prevent the passage of stray gases. If this regulation is not at present being observed an exhibitor should draw the attention of the Supply Authority concerned to it as it is the Authority's responsibility to ensure that the service enters the building in the required manner.

Any holes in an interior fire-resistive wall or floor through which pipes, ducts or conductors pass are also required to be sealed, but in this case it is to prevent the passage of fire and smoke.

The sealing of service pipes is a new requirement as far as Cinematograph Regulations are concerned, but it is a requirement contained in the Regulations under the Gas and Electricity

* Cinematograph Exhibitors' Association.

Acts. The latter was previously required only in the case of holes made in the walls or floor of the enclosure but it is now extended to include all fire-resisting walls and floors.

REGULATION 4

In the event of fire it is considered essential that the fireman should be able easily to cut off the gas supply to the premises. This regulation requires the control point to be placed as near as practicable to a door accessible from the highway.

This is a new requirement which does not appear to take into account that the gas service may enter the kinema at a point well away from a highway. If in such a case the service is extended internally and a cock fitted, the fireman may turn off the gas as intended and yet defeat the whole purpose by leaving a "live" gas pipe inside the building. In such cases the exhibitor should seek technical advice.

Lighting

The object of the following requirements regarding general and safety lighting is to ensure that the premises are normally sufficiently well lighted, and in the event of failure of either system the public will still be able to see their way out from any part of the premises which may be accessible to them. In framing these regulations particular care has been taken to ensure that the two systems are so independent that a fault on the one would be extremely unlikely to affect the other.

REGULATION 5—General Lighting

Except where lighted by daylight, all public parts of the premises must be adequately illuminated by the general lighting, which may be either gas or electricity.

REGULATION 6—Dimming

The auditorium general lighting may be dimmed. Where the lighting is by gas the regulator must not be installed in the projection room or in any other place where film is used or taken. Where the lighting is by electricity the dimmer may be fitted or installed in the projection room but not in the rewind room or film store.

Whatever the method of dimming, independent means of regulation must be installed away from places of special hazard, viz., the stage and any place where film may be taken, so that in the case of an emergency any member of the staff can bring the general lighting to full brilliancy. In selecting the position of this independent control it should be borne in mind, therefore, that it should be easily accessible to the staff even in a panic.

REGULATION 7—Safety Lighting

Safety lighting is required in the auditorium

and, in the absence of adequate daylight, in all exits leading to the outside, all courts, passages, stairways and other public parts of the premises, and must be in operation all the time the public are present.

The safety lighting source may be electricity, gas, certain oil lamps, night light lamps or candles, and whatever the source it must be (except in the case of floating or trickle charge batteries) entirely independent of the general lighting.

If electrical safety lighting is installed the conductors must not be contained in the same conduit or cable as conductors used for any other purpose, e.g. general lighting.

Control of the safety lighting must not be located on the stage, in the projection suite, film store or any place accessible to the public.

Exit Signs

All exit signs are required to be illuminated simultaneously by both the safety lighting and general lighting systems all the time the public are present.

If a flame illuminant is used in one of the systems it must not be installed so that it can damage any electrical wiring or fittings. Thus with electrical general lighting and gas safety lighting it is preferable to install one system in the sign and one outside. The decision which would be preferable inside must, to some extent, depend on particular conditions, but it should be borne in mind that gas internally involves increased maintenance and cleaning; gas points externally must be kept away from draughts.

The most important consideration is that if either one of the lights should fail the sign should remain fully legible. To ensure that signs will have lettering and illumination for optimum legibility and adequate brightness the British Standards Institution will shortly be publishing a specification dealing with these signs.

REGULATION 8—Safety Lighting Batteries

Where the safety lighting source is a battery of accumulators which discharge during normal use, it must be fully charged before the premises are opened to the public and, in addition, its capacity must be sufficient to supply the full load at normal voltage until the public leave.

REGULATION 9—Floating Batteries

The safety lighting source may be a floating battery provided its capacity is sufficient to supply the full load at normal voltage for three hours. The charging arrangements must be such that the battery does not normally discharge when connected to its full load. If the charging apparatus, which must not be used for any other purpose, is of a type that permits a reversal of current in the event of a failure in the mains supply, as in the case of a motor generator, automatic switching must be provided to disconnect the supply. The switchgear must be tested each day before the

premises open to ensure that it is in a working condition.

To warn the staff that a failure of the battery charging source has occurred, with the result that the battery is discharging, an arrangement is required to be made so that a visual or audible warning signal is given to an authorised person.

REGULATION 10—Trickle Charge Batteries

This regulation permits the safety lighting normally to be supplied from the same source as the general lighting. If this source should fail the safety lighting load is required automatically to be switched over to the storage batteries. With this system the requirements applicable to floating batteries must be complied with and, in addition, the automatic change-over switch is required to be in accordance with the relevant British Standard Specification, and as an additional safety measure it must be able to carry an excess load of 50%.

Although some licensing authorities did not object to such a system, the 1923 Regulations did not permit it, with the result that it has previously been installed in some parts of the country and not in others. This anomaly has now been removed, and steps are being taken to manufacture individual exit signs each complete with a trickle charge battery, change-over switch, and illuminated sign which will merely require to be plugged into an adjacent socket outlet. Due to the fact that installation costs with this system will be greatly reduced, it is considered likely that it will prove attractive to small halls.

REGULATION 11—Failure of Lighting

This regulation deals with conditions which require the public to leave the premises in the event of failure of the lighting.

Where the general lighting is by electricity, in the event of a failure not being restored within one hour, the public are required to leave the premises. If the lighting is by gas the public must leave immediately.

If the safety lighting is by electricity and it should fail, the public must leave the premises if it is not restored within one hour, but where it is other than by electricity, the auditorium must be fully illuminated by the general lighting and the public leave the premises immediately.

If the battery charging source of supply fails the public are required to leave the premises within one hour unless the supply has been restored. Before the public are readmitted the battery must be fully charged.

REGULATION 12—Electrical Requirements (General)

The foregoing regulations apply to electrical installations whether the supply is taken from a Supply Authority or from a private generator set. However, they do not apply to any sub-station which may be located upon the premises. In the

latter case it was considered that as the keys of such sub-stations are usually held by the Supply Authorities the responsibility for taking adequate precautions should lie with the Authority and not with the exhibitor.

In general, the electrical installation is required to be in accordance with the I.E.E. Regulations for the Electrical Equipment of Buildings current at the time of installation and, in addition, all materials and apparatus are required to comply with any relevant British Standard Specification current at the time of installation.

Whilst the 1923 Regulations required compliance with the I.E.E. Regulations, the reference to British Standard Specifications is a new one and one that may cause difficulty if applied literally. Under this regulation, if materials and apparatus, not being in accordance with any appropriate British Standard Specification which may have existed at the time of installation, were installed in a kinema prior to the publication of these new Regulations, such apparatus and materials will be required to be replaced in 1953. Such an interpretation could be most onerous and it is not considered that the intention was to make this requirement retrospective.

The remainder of this regulation deals with the protection of circuits and the earthing of all metal work which may become live under fault conditions.

REGULATION 13

Requires open type switchboards to be situated in a room accessible only to authorised staff, otherwise all main supply and main circuit switchgear is to be metal-clad and fused on each live pole. The fuses may be contained in the switches or in separate metal boxes.

Switch lampholders are prohibited in the public parts of the premises other than in cafés. All exterior lights are required to be controlled by switches easily accessible to the staff. Other than the door operated type, switches must not be exposed to unauthorised interference.

REGULATION 14

Requires a mounted and framed diagram showing the general arrangement of electrical circuits to be fixed near the main switchgear.

REGULATION 15

This regulation is possibly one which will affect the most kinemas as it requires wiring to be protected by heavy gauge solid drawn or welded screwed steel conduit or steel armouring or other hard metal sheathing with positively clamped or equivalent joints. The covering is required to be electrically and mechanically continuous.

Thus light gauge (slip) conduit with clamp joints, lead covered cable, rubber covered cable and cable protected by wood casings are all excluded. These excluded materials, which can be

found in many of the older cinemas, will be required to be replaced by January, 1953.

Due to the special considerations involved, this Regulation does not apply to necessary flexible conductors, battery connecting conductors, bell or similar wiring, organ wiring, wiring for battery depolariser circuits, high voltage circuits of illuminated discharge tube installations or to temporary wiring or wiring under repair and alterations, the latter being subject to any conditions made by the licensing authorities.

Conductors which have to be flexible must be as short as possible, and where necessary protected by tough rubber sheathing, flexible metallic tubing or other suitable material being mechanically fixed and reinforced at the point of entry into all fittings and apparatus. If such conductors are used in positions where they are likely to be subjected to heat, e.g. arc lamps, they are required to be protected by heat resistive material.

Refrigerators and cooking appliances are required to be connected by fixed wiring in conduit; thus it is no longer permissible for the former to be supplied from a socket outlet as has hitherto been customary practice. The connection of some appliances by fixed wiring in conduit will involve considerable difficulty, particularly in so far as maintenance is concerned, and indeed in some instances compliance may prove impracticable.

All socket outlets and plugs, except those forming part of the stage installation, are required to be constructed so that pins of plugs cannot be touched whilst they are live and those accessible to the public must be controlled by an adjacent interlocked switch. This latter requirement does not apply to those socket outlets associated with certain low voltage circuits, e.g. deaf aids, etc.

All portable apparatus and lamps are required to be connected by means of the approved type socket outlet, and lamp holder plugs are prohibited.

Wiring must not be placed in any ventilating passage or duct. The interpretation of this regulation could lead to misunderstandings but its purpose is obviously to guard against unprotected wiring being placed in ventilating ducts. If the wiring is protected by being enclosed in conduit there is no reason whatever for it being excluded from these places.

REGULATION 16

The first section of this regulation requires all terminals and current carrying parts of the electrical installation and equipment to be enclosed so as to prevent accidental short circuiting.

So as to ensure that the guard is also properly ventilated no cover must be placed over it and the top is required to be shaped so that articles cannot be placed upon it.

This regulation is obviously to guard against the possibility of reels of inflammable film being placed in positions where they are likely to ignite,

but it would be difficult to produce instances where apparatus of this type has been the cause of film fires.

As heat deteriorates most forms of insulation, cables must not be placed closely above heated surfaces.

Where rectifiers are used behind the screen for the excitation of loudspeakers, they will have to be enclosed by a perforated metal guard in such a manner that there will be no restriction of ventilation.

REGULATION 17

This regulation deals with accumulators and ancillary equipment. Open type accumulators are to be installed in specially reserved rooms or compartments, otherwise they must be completely enclosed, including terminals, in material which does not readily catch fire. Celluloid containers are prohibited.

Where accumulators are used to supply either the general or the safety lighting the output must be protected by fuses or circuit breakers located near to the battery but not in the battery room. This latter requirement is designed to prevent the ignition of inflammable vapours, and the chemical deterioration of equipment which may arise where lead-acid types of accumulators are installed, but it would appear to be an unnecessary precaution in the case of the nickel-iron batteries.

Accumulators used for the safety lighting system must not be used for any other purpose.

To ensure that the battery is maintained in a satisfactory and serviceable condition and that its capacity is sufficient for its purpose, it is required that it should be inspected by a competent person every six months. Also every six months, it must be discharged through the normal load, the results being recorded for the examination of the licensing authority's official.

REGULATION 18

This regulation contains special requirements applicable to all luminous discharge tube installations irrespective of working voltage and location.

If the characteristics of the discharge lamps are such that fuses would not protect the circuit against excess current, it is required that special automatic cut-outs be provided where the rated electrical input to the tube or series of tubes exceeds 500 volt-amperes. A similar requirement is contained in the I.E.E. Regulations, but in the latter case it is applicable only where the pressure exceeds 650 volts.

The control apparatus, e.g. chokes, transformers, starter switches, power factor correction condensers, etc., are all required to be protected by metal enclosures. This requirement is not only for the protection of the equipment itself but also to protect any member of the public or staff from possible shock if they came into contact with the

live terminals. To reduce fire hazard it is also required that the apparatus shall not be installed in the spaces between a ceiling and the floor boards above.

Transformers and choke coils are to be of the fixed reactance type. This would appear to exclude discharge tube lighting when the dimming is affected by variation of reactance. Such would be a very onerous restriction and it is thought that as such means of dimming has only recently been perfected the requirement was drafted prior to the development. Almost certainly steps will be taken to remove this anomaly which has arisen due to progress outpacing legislation.

No oil or inflammable material which is fluid at normal working temperatures is to be used for insulation purposes in any part of the discharge tube apparatus. If the tubes are placed within reach of the public they must be protected so that if a tube is broken a live electrode cannot be touched.

REGULATION 19

This regulation deals specifically with luminous discharge tube installations where the pressure between any two parts of the installation exceeds 650 volts (i.e. high voltage).

When cables are installed in positions where they may be mechanically damaged they are required to be armoured or suitably protected. It is to be noted that in this instance conduit is not considered to be suitable protection. Unarmoured lead cables must not be drawn into conduits except for short lengths passing through a wall or floor, and all metal, including such short lengths of conduit, must be earthed.

All metal parts of the installation, including transformers, liable to be charged at high voltage in the event of a defect occurring are required to be earthed independently of the earthing path of the metal conduit or sheathing. This will undoubtedly necessitate an additional earthing conductor being provided in the majority of neon and other high voltage installations.

If the characteristics of the circuit are such that fuses or similar excess current devices are ineffective, automatic cut-outs must be fitted even if the rated electrical input is below 500 volt-ampères. This will affect many kinemas which have cold cathode lighting fittings installed in vestibules or cafes, as irrespective of the input wattage, if the voltage is in excess of 650 volts cut-outs must be installed. It has been stated that at the present time there is no cut-out manufactured suitable for an input below 500 watts, and for this reason exhibitors are unable to comply with this regulation.

Previously, firemen's switches controlling outside high voltage installations have been required to be fixed on the exterior of the building. But now exterior switches must be installed also for the control of any fixed interior installations. The

I.E.E. Regulations require such provision only if the interior installations are run unattended, and it is difficult to understand why this extra safety precaution has been imposed on cinematograph theatres. Indeed, the requirement in no way enhances the safety of such premises because these circuits are never left unattended and are always under the ready control of the staff.

The transformer rating of a transportable self-contained high tension luminous discharge tube unit must not exceed 100 volt-ampères and any luminous discharge tube installations running unattended within a building for any display or window lighting must be controlled by a conspicuous switch located at the main entrance of the building or, in exceptional circumstances, in any other position approved by the licensing authority.

The foregoing two regulations dealing with discharge tube installations have been criticised as being excessive and far exceeding the precautionary standards which experience has shown to be adequate. It is true that they are more stringent than those of the Institution of Electrical Engineers, which have been designed to cover installations in more hazardous situations than kinemas. Indeed, the I.E.E. Regulations are adequate for installations in garages and other places where there is a likelihood of the apparatus operating in an atmosphere containing inflammable vapours.

REGULATION 20

Deals with electrical apparatus which requires to be installed in separate rooms, from which the public are excluded. It requires that generating plant driven by gas, oil engine or other prime movers, main supply and main circuit transformers, shall be installed in enclosures not communicating directly with the auditorium or an exit way. The enclosures must be constructed so as to prevent the spread of fire.

The main supply and main circuit switchgear is also required to be installed in an enclosure and the door kept locked if it communicates with the public parts of the premises. Some licensing authorities have endeavoured to go well beyond this requirement and have demanded intake rooms of fire-resisting construction with fire-resisting doors, etc., but experience has shown that the fire risk in intake rooms is negligible, especially when all switches, busbars, etc., are ironclad.

The lighting in projection rooms, rewind rooms, film stores, is required to be by electricity supplied from sub-circuits separate from the general or safety lighting systems. Thus safety lighting is now permitted in the projection suite. It is, however, to be noted that the regulation does not require that the enclosure, etc., must be illuminated by the safety lighting, it being left entirely to the discretion of the exhibitor, who may, if he so wishes, now provide it in these

places. The permanent lighting fittings are to be fixed in position with the conductors enclosed in rigid or flexible metallic tubing—again lead sheathed cable is specifically excluded from interpretation as flexible tubing. If the lighting is by a luminous discharge tube it must either be placed out of reach or the lamp and the lamp holder be totally enclosed; all fittings, including portable lamps, are to be of substantial construction.

Any switch or dimmer cover installed in those places where film is taken is required to be so constructed as to prevent the accidental admission of film.

Illuminated viewing devices on the rewind bench are to be constructed so as to prevent film cuttings entering them.

It is required that all metalwork of apparatus associated with or used for the rewinding of film be electrically connected together and efficiently earthed. This regulation, which is designed to avoid ignition of the film cement vapours by static discharge from the film, may be considered by some authorities in the trade to be entirely unnecessary. Whether or not a case can be made out for the claim that film fires have been caused by static discharge, this regulation will prevent any arguments arising after January 1, 1953, as the static excuse—if indeed it be an excuse—will no longer be acceptable. For this reason, if for no other, the regulation has much to recommend it. Unfortunately, the words "associated with" could lead to misunderstandings. It is reasonable to assume that rewinders should be earthed, but splicers, waxers, etc., may be considered, by some as being associated with rewinding and, therefore, require to be electrically connected together and earthed. It is not, however, considered that the inclusion of these ancillary items of equipment is intended and it is to be hoped that no authority will so interpret it.

The only electrical apparatus allowed in the rewind room is that used for lighting or heating; thus such things as motor driven rewinders and fans are excluded. In the film store no electrical apparatus other than that for lighting is permitted.

REGULATION 21

Deals with the electrical requirements appertaining specifically to apparatus installed in the projection room, and it is to be noted that main supply and main circuit switchgear and fuses are excluded.

Transformers (which must be double wound), rectifiers and choke coils are not allowed to be used other than for supplying arc lamps, sound equipment or television apparatus, and in addition must be guarded or enclosed so as to prevent ignition or decomposition of film. No external surface of a guard or enclosure shall exceed a temperature of 212° F. and the top shall be so shaped as to ensure that nothing can rest upon it.

Reasonable interpretation of the first part of this regulation will be required, otherwise chokes for luminous discharge tube lighting fittings may be excluded.

Transformers, rectifiers, choke coils, contactor and other coils must comply with the relevant B.S.I. limits of temperature rise and the current of each component shall not exceed an output equivalent to 20 KVA for each converting unit.

If the pressure of the supply to the arc or any other type of projector exceeds 250v. D.C. or 125v. A.C. between conductors at the lamp terminals, all access doors are to be interlocked with the supply to ensure that the lamp terminals are not live when the door is opened. The 1923 Regulations prohibited in the projection room a pressure in excess of 250v. D.C. or 125v. A.C. for the projector circuit. This revision will now permit inductors for A.C. arc lamps to be installed in the projection room and also three-phase rectifiers for a D.C. arc supply.

If the light source is an electric arc, an ammeter is required to be inserted in each projector arc circuit and the insulating supports for all arc electrodes are required to be kept clean and free of conducting dust.

The supply to the projectors is required to be from a main circuit separate from that of the general lighting and provision must be made in the projection room so that all voltage may be cut off from the arc, driving motor, sound reproduction equipment and all effects lamps, etc. Means must also be provided within easy reach of the projectionist for individual isolation of each projector and its converting apparatus.

No contactors, circuit fuses, circuit breakers, or switches are to be installed in the projection room other than those required for the operation of the projectors, sound equipment, spotlight effects lamps, television apparatus or for the control of the general lighting. As this requirement would be most onerous if enforced in the case of existing buildings, a proviso is made that it shall not apply to such parts of the electrical installation of the premises as were in use before the coming into force of these new Regulations, unless they have been altered or renewed.

If a cover or door is fitted to a sound reproduction apparatus for the replacement of valves, any live terminals which may be exposed when the door is opened must be guarded or an interlock fitted to the door so that the supply is disconnected when the door is opened. All parts of the sound equipment must be suitably protected from risks arising from the failure of insulation or overloading, and the pressure of D.C. circuits installed for excitation of loudspeakers shall, after the Regulations are in force, not exceed 250 volts.

REGULATION 22

Contains special requirements appertaining to organ electrical equipment. The wiring of organs

and such ancillary equipment as blowers, motor generators, lifts, decorative lighting, etc., is required to be placed in flexible metallic tubing when the console is movable. Again lead sheathing and lead covered cable is not considered to be metallic tubing for this purpose. Taken literally, this regulation would mean that if the console is movable all the wiring associated with it must be in flexible metallic tubing, whereas, in fact, the intention is undoubtedly to require that wiring from the movable console to the nearest convenient fixed position must be so enclosed in flexible metallic tubing. Where such wiring is enclosed in metallic tubing it must be insulated and further protected by non-metallic fire-resisting wrapping or sheathing. Wiring actually in or on the console, however, is not required to be enclosed in either conduit or flexible metallic tubing.

The voltage of the circuits controlled by the keyboard must not exceed 30v.

Due to the fact that mice and similar vermin find organ consoles admirable homes and the wiring insulation excellent food, it is required that a clear glass inspection cover be provided so that the inside of the console can be examined. The regulation, however, does not demand that any action shall be taken to eliminate the intruders.

The electrical input to organs must be fused and, where practicable, also the sub-circuits in the various sections, including keyboard circuits.

Provision must be made for cutting off all voltage from the electrical wiring and apparatus of the organ and a warning pilot light must be fitted which is illuminated when any part of the electrical wiring is energised.

The last section of the Regulations contains various requirements applicable to television equipment installed in cinemas, but due to short-

age of space and the fact that at present it would be of only academic interest, a detailed report upon this particular section has been omitted.

Conclusion

It should be noted that these new Regulations apply in England and Wales but do not extend to Scotland.

From a technical viewpoint the Regulations represent a good standard of electrical engineering practice designed to reduce fire hazards and to promote the safety of all who may enter upon the premises. Indeed, the electrical fire hazard of a cinema which complies with these Regulations will be infinitely less than that of the majority of public and private premises.

A few of the Regulations are obviously based upon the continued use of inflammable film and will require to be reviewed when safety film is used exclusively. There are others which may be misinterpreted but it is to be anticipated that common sense will iron out any minor difficulties which may arise.

From the exhibitors' viewpoint they represent a very heavy financial burden. It is doubtful whether any cinema in the country complies entirely with the Regulations and many cinemas will have to be entirely re-wired. To add to the difficulties, their publication was co-incident with a substantial rise in prices, and much of the work will probably be delayed because of the rearmament programme.

PERSONAL NEWS OF MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

C. H. BELL is responsible for modifications to the Oemichen Guild-Arc 16 mm. projector for production in this country.

HENRY HARRIS has been working in Spain on a new colour process.

BRIGADIER J. L. HEYWOOD, Assistant Secretary of the K.R.S., is Chairman of the joint Film

Damage Advisory Committee.

T. W. HOWARD is responsible for the optical work on "Quo Vadis," which was filmed in Italy.

P. G. A. H. VOIGT is an instructor in electronics at the Ryerson Institute of Technology, Toronto; his spinal trouble is showing improvement.

FROM THE OVERSEAS PRESS

NEW EASTMAN IDENTIFICATION SYSTEM FOR SAFETY FILM

Nitrate stock is identified by a small mark every fourth perforation, in the margin; safety stock carries a longitudinal mark every fourth perforation, in line with the perforations. (British safety stock is identified by the latter S.)—*Inter. Proj.*, March, 1951.

LIGHT SOURCE FOR TV NEWSREEL CAMERAMEN

A lighting equipment for news-reel work consists of a 32v. battery feeding a 30v. 250-watt 3-hour photo-flood lamp. The battery weighs only 18 lbs. The lamp unit is clipped on to the Filmo camera.—*Amer. Cine.*, Feb., 1951.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

THE STORAGE OF CELLULOID

F.P.A. Journal, Oct., 1950, p. 132.

The report of a Home Office committee on the storage of celluloid (H.M.S.O. Cmd. 7929), recommends that existing regulations on the storage of celluloid be strengthened.

R. H. C.

SYNTHETIC COLOUR-FORMING BINDERS FOR PHOTOGRAPHIC EMULSIONS

H. B. Sennings, W. A. Stanton and J. P. Weiss, *J. Soc. Mot. Pic. & Tel. Eng.*, Nov., 1950, p. 455.

The development of synthetic colour-forming binders and their application to photographic emulsions is discussed. These accomplishments have made possible the manufacture of a release positive colour film designated DuPont Type 275. A résumé of some of the novel features of the stock is given and the utilisation of the material as a colour release medium is covered. Details of the printing and processing of both picture and sound records are given.

AUTHOR'S ABSTRACT.

FOREIGN VERSIONS

Victor Volmar, *J. Soc. Mot. Pic. & Tel. Eng.*, Nov., 1950, p. 536.

The various techniques employed in the preparation of foreign versions as practised in the United States are described. The prevailing system for dubbing in America is shown to be that of employing short loops. Spoken and written rules and censorship regulations in most countries have been charted.

W. DE L. L.

INTERMITTENT MOVEMENT DEVICES AND FILM STRAIN

E. May, *Foto-Kino-Technik*, Sept., 1950, p. 270

Following a survey of the kinetic characteristics of the normal four-sided 90° Maltese cross, other devices capable of more rapid film shift are considered. A device suitable for sub-standard mechanisms is capable of a shift period as rapid as 1 in 30.

R. H. C.

INTERFERENCE MIRRORS FOR ARC PROJECTORS

G. J. Koch, *J. Soc. Mot. Pic. & Tel. Eng.*, Oct., 1950, p. 439.

The convex surface of the glass mirror blank is coated with a sandwich layer of interference films instead of the usual silver. Visible light is reflected with efficiency equal to or better than silver, but most of the infra-red and near ultra-violet radiation from the arc is transmitted through the mirror. There is much less heat at the rate than with silvered mirrors. The colour quality of the illumination can be controlled by variation of the thickness of the interference films.

A. H. A.

VENTARC HIGH-INTENSITY PROJECTION LAMPS

E. Gretener, *J. Soc. Mot. Pic. & Tel. Eng.*, Oct., 1950, p. 391.

In the Ventarc projection lamp, the flame is maintained central and efficiency improved by means of an air blast, concentric with the positive carbon. Evenness of light distribution is achieved by magnetic rotation of the arc gases. A photo-electrically controlled feed device is claimed to maintain the crater position accurate to within ± 0.1 mm. In the larger models, the negative electrode takes the form of a rotated ring of carbon.

R. H. C.

A HEAVY-DUTY 16 mm. SOUND PROJECTOR

E. C. Fritts, *J. Soc. Mot. Pic. & Tel. Eng.*, Oct., 1950, p. 425.

In a new 16 mm. projector, separate motors drive respectively the intermittent motion, the shutter-sprocket system, the take-up, the rewind, and the blower. The intermittent motion consists of an accelerated 8-picture Maltese cross; provision is made for initial phasing of motion and shutter. Either tungsten or arc illuminant can be used. Sound pre-amplifier is mounted in the projector, and main amplifier in the pedestal.

R. H. C.

A MAGNETIC RECORD-REPRODUCE HEAD

M. Rettinger, *J. Soc. Mot. Pic. & Tel. Eng.*, Oct., 1950, p. 377.

The paper describes the construction of a novel magnetic head used for recording as well as reproducing and the influence of various factors such as the thickness of the laminations, front gap and rear gap is discussed. To meet the sometimes opposing requirements for recording and reproducing with the same head a compromise is arrived at and details are given of the final combined recording and reproducing head.

O. K. K.

LIGHTING FOR TELEVISION

R. H. Cricks, *Functional Phot.*, Nov., 1950, p. 22.

A survey of the requirements of television lighting includes data of the equipment at Alexandra Palace.

AUTHOR'S ABSTRACT.

THE COUNCIL

Summary of the Meeting held on Wednesday, May 2, 1951, at 117, Piccadilly, W. 1

Present : Mr. A. W. Watkins (*President*) in the Chair, and, Messrs. L. Knopp (*Vice-President*), H. S. Hind (*Hon. Treasurer*), B. Honri, T. W. Howard, N. Leever, S. A. Stevens and R. J. T. Brown (*representing Papers Sub-Committee*).

In Attendance : Miss J. Poynton (*Secretary*).

COMMITTEE REPORTS

Journal and Papers Committee.—Careful consideration had been given to the question of the Presidential Award, which is presented to the author who delivers the most meritorious paper during the Presidential term of office. The recommendation was submitted for approval:

"That the Presidential Award for the period 1949/51 be made to Hugh McG. Ross, M.A., for his paper entitled 'The Heating of Films and Slides in Projectors.'"*—Report received and adopted.*

Film Production Division.—The programme for the 1951/52 Session is progressing. The series title for the papers will be "Long Term Development in the Industry."*—Report received and*

adopted.

Theatre Division.—The *ad hoc* Committee appointed to formulate recommendations concerning the apprenticeship and certification of projectionists intends to commence work immediately.*—Report received and adopted.*

Television.—The meeting with representatives of the Television Society referred to in the last report has now taken place. As a result of the deliberations the Kinematograph/Television Group will be put into operation for a preliminary period of one year.

No fee will be charged for membership of the Group. Two courses of four lectures each will be arranged during the 1951/52 Session and the fee will be 15s. per course for members and 30s. for non-members. Full publicity will be given when the Group is open to receive applications for membership.

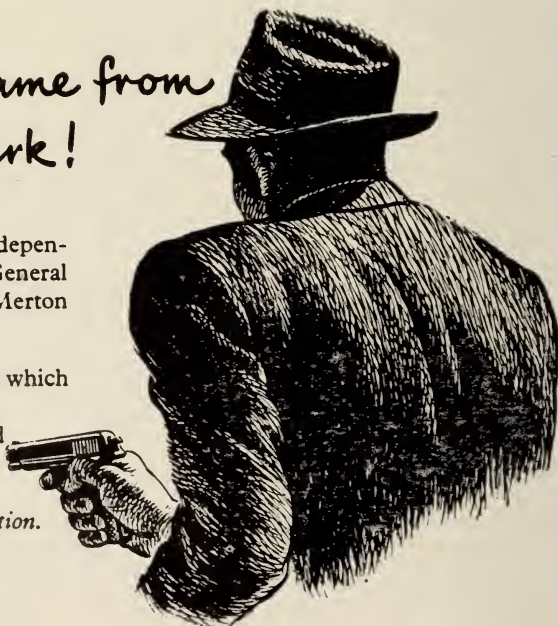
Retiring President.—Mr. A. W. Watkins, President since 1949, has thanked members for their support during his term of office.

The proceedings then terminated.

'The Dark Man' came from
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"The Dark Man," produced by Independent Artists and distributed by General Film Distributors, was made at Merton Park Studios.

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BRITISH KINEMATOGRAPHY

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THE BRITISH KINEMATOGRAPH SOCIETY
117 PICCADILLY, LONDON, W.1. GROsvenor 4396-7

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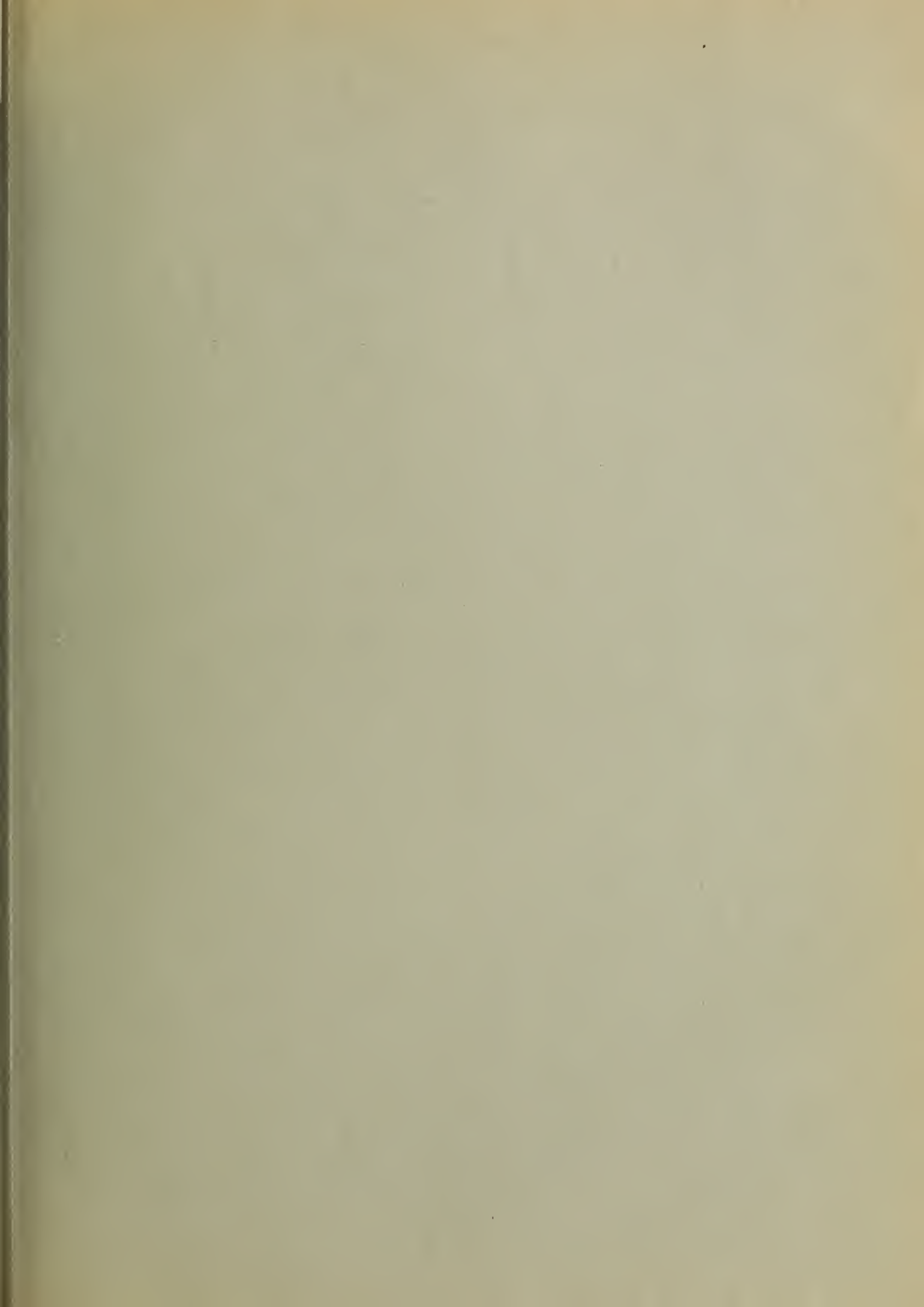
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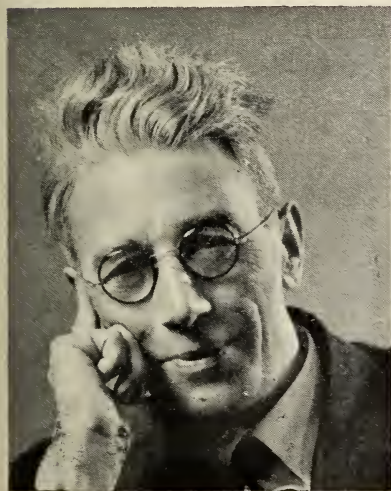
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THE NEW PRESIDENT



Dr. Leslie Knopp, our new President, is a man of wide interests and attainments. He was educated at Glasgow and in 1920 was awarded the King's prizemanship in mathematics and subsequently gained a post-graduate scholarship in engineering. He is a Doctor of Philosophy, a Master of Science, Fellow of the Physical Society and of the Illuminating Engineering Society.

He entered the kinematograph industry in 1931 when he joined the Engineering Department of Gaumont British Picture Corporation and subsequently, in 1936, he was appointed technical adviser to the Cinematograph Exhibitors' Association.

During the war, he held an important position in the Directorate of Naval Construction and was principally engaged in the production of vessels and equipment for anti-submarine and anti-aircraft defences, returning to the industry on the cessation of hostilities.

He has been a representative of the industry on the Divisional Council of the British Standards Institution, of the Home Office Advisory Panel and other technical bodies.

He joined the British Kinematograph Society in 1938 and has been a member of several committees. His work as chairman of the Papers Committee and on the Council of the Society has been invaluable and in 1949 he was elected Vice-President.

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NEWLY ELECTED HON. FELLOWS AND FELLOWS

HON. FELLOWS



ERNEST E. BLAKE



Sir SIDNEY HARRIS



HERBERT T. KALMUS

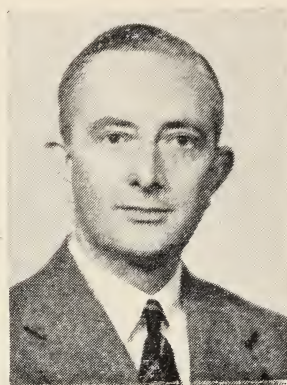


A. W. WATKINS

FELLOWS



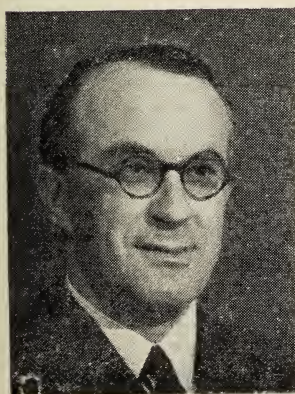
MARCUS F. COOPER



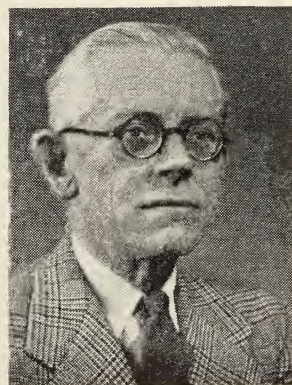
C. G. HEYS HALLETT



A. JUNGE



F. S. HAWKINS



R. McV. WESTON

CONFERMENT OF HON. FELLOWSHIP AND FELLOWSHIP

At the second Convention of the British Kinematograph Society, held on May 5, 1951, the following conferments of the Hon. Fellowship and Fellowship were announced.

HON. FELLOWSHIP

ERNEST EDGAR BLAKE

Commenced taking and showing Kinema films 1897. Joined Kodak Ltd., 1903. From 1903-1927 Chief Technician, Kodak Cine Department. From 1946 Chairman, Kodak, Ltd., and General Manager European and Overseas Kodak Companies. Chairman of the Kinematograph Manufacturers' Association.

For his interest and influence in the advance in motion picture technology in Great Britain over a considerable span of years, during which time

there are few aspects of motion picture technique which he has not helped to stimulate.

SIR SIDNEY WEST HARRIS, C.B., C.V.O.

Since 1947, President of the British Board of Film Censors.

Sir Sidney West Harris was appointed President of the British Board of Film Censors in 1947. Educated at St. Paul's School and Queen's College, Oxford, he entered Government Service. His principal work was in the Home Office, where as Assistant Under-Secretary he was responsible for questions concerning probation, approved schools and child welfare. From 1922 onwards he

represented Great Britain on the Permanent Advisory Committee of the League of Nations on social questions, and in 1946 on the Social Commission of the United Nations.

Since entering the film industry, Sir Sidney has shown keen and lively interest and appreciation of the manifold factors associated with the censorship and exhibition of films.

HERBERT THOMAS KALMUS

President of the Technicolor Motion Picture Corporation of America. Chairman of Technicolor, Ltd. Great Britain.

A native of New Zealand, Dr. Kalmus took his degree of Bachelor of Science at the Massachusetts Institute of Technology in 1904. This was followed by a period of study in Europe, first at the University of Berlin and then at the University of Zürich, where he completed his work for a degree of Doctor of Philosophy. Returning to America, Dr. Kalmus spent the next six years in the laboratory of his *alma mater* as Research Associate conducting experimental investigations in the field of physical chemistry. He next joined, by invitation, the Faculty of Queen's University, Kingston, Ontario. As a result of his work there the Canadian Government appointed him Director of Research in the laboratory of electrochemistry and metallurgy.

Such, briefly, was Dr. Kalmus's background when he organised, in association with Dr. D. F. Comstock, the firm of consulting engineers Kalmus, Comstock and Westcott, Inc. This organisation was formed to investigate and solve industrial problems and in this it met with considerable success. One problem, however, which had been exercising the minds of scientists and others for some considerable time and which remained unsolved, was that of colour cinematography.

It was in about 1916 that Dr. Kalmus organised and directed a group of technicians whose researches and experiments yielded the first two-colour additive Technicolor process. This he

rejected in favour of experiments which produced a two-colour subtractive process. Still not satisfied, Dr. Kalmus continued his researches in order to achieve his ambition, which was to bring all of the spectrum to the screen. Finally, there emerged the first practical three-colour subtractive process. The rest is common knowledge.

In the early days of this work, film apparatus and processes were not greatly advanced and many problems had to be solved that were not ostensibly connected with colour cinematography. As the experiments developed not only had the technical problems to be analysed and only the fruitful lines pursued, but a small staff of specialist technicians had to be chosen and briefed to act as assistants.

In addition to possessing the qualities essential for such an undertaking, Dr. Kalmus, through his determination and enthusiasm, won the friendship and support of those who were able to give financial backing to a venture which at times seemed to be far from succeeding.

To-day, at the age of 69, Dr. Kalmus is the vital and energetic General Manager of the Technicolor Motion Picture Corporation of America. As recent announcements have shown, the work of experimentation still goes on under his tutelage.

There is no doubt that in the history of motion picture development the name of Dr. Kalmus must be prominently linked with the solution of the problem of colour cinematography.

ALFRED WILLIAM WATKINS

Director of Recording, M.G.M. British Studios, Ltd.

For valuable services rendered to British cinematography and to the Society.

FELLOWSHIP

MARCUS FREDERICK COOPER

1921-1929 Scientific Research under Sir R. H. Pickard, D.Sc., F.R.S.; 1929-1930 Sound Department, Gainsborough Studios, Ltd. 1930-1931 Recordist, British Lion Studios. 1931-1932 Chief Recordist, Ealing Studios, Ltd. 1932-1939 Merton Park Studios, Ltd. 1945 Managing Director, Marcus Cooper, Ltd.

In 1931, Mr. Marcus Cooper designed a studio control organ for Ealing Studios, Ltd., an apparatus which showed an early appreciation of the need for economy and efficiency in film production. Later much valuable information was obtained from his researches into volume compres-

sion systems for sound recording and time lapse cinematography applied to marine radar. In 1940 he produced a very useful chart for the correlation of photo-electric exposure meters. He is at present engaged in scripting and directing scientific and industrial films.

CHARLES GORDON HEYS HALLETT, M.A.(Cantab.), A.I.P.E.

1927-1947 General Manager, Arc Lamp Carbon Department, Morgan Crucible Co., Ltd. 1947 Managing Director and Director of Research, Mole Richardson (England) Ltd.

By his researches and inventions in high-powered and water-cooled arcs and compact-source studio lamps, Mr. Heys Hallett has contributed to the development and improvement of

light sources for studio photography, and has from time to time contributed papers of considerable merit before the Society.

FRANK SWAIN HAWKINS, B.Sc., Ph.D., A.R.I.C.

1925-1930 Assistant Lecturer in Chemistry, University of Sheffield. 1930 Member of leading scientific staff of the General Electric Co. Ltd. Research Laboratories.

For research work directed to the advancement of every branch of illumination for cinematography, but in particular studio arc lamps and their supply; for his original research in photo-

metry, and for the generous manner in which his specialised knowledge has always been placed at the disposal of the motion picture industry.

ALFRED JUNGE

Since 1919 Art Director of Ufa, Germany, Dupont and Mr. (now Sir) Alexander Korda, Paris, and B.I.P., Gaumont-British, British National, Metro-Goldwyn-Meyer, and Archers Film Productions.

Mr. Alfred Junge is known as a technician and artist of outstanding ability. He has held a position of distinction in the Art Direction field of British films for more than twenty years, during which time his work has been internationally acclaimed. Amongst the many great British films which his work has enhanced, "Goodbye, Mr.

Chips," "A Matter of Life and Death" and "Colonel Blimp" are outstanding. He received the Academy of Arts and Sciences Award for his work in "Black Narcissus."

He is President of the Society of British Film Art Directors and Designers.

ROBERT McVITIE WESTON, M.A., F.R.P.S., F.R.M.S.

1940-1945, Head of the Photographic Section of the Ministry of Supply Chemical Defence Experimental Station. 1947, Founder and Director, Simpl, Ltd.

By his application to the problem of using the motion picture camera as an aid to research, Mr. McVitie Weston is rendering a valuable service to

cinematography. His experience and his original work in this specialised field are worthy of recognition.

SECOND ANNUAL CONVENTION

The second Convention of the British Kinematograph Society was held at the Gaumont-British Theatre, Wardour Street, London, W.1, on Saturday May 5, 1951.

The proceedings opened with the annual general meetings of the three Divisions, which were followed by the fifth Ordinary Meeting of the Society. The elections showed that Mr. R. J. T. Brown had been elected Hon. Secretary, and that Dr. F. S. Hawkins had joined the Council.

The Ordinary Meeting was followed by the presentation of certificates to the newly elected Hon. Fellows and Fellows. The Presidential Award for the period 1949/1951 was made to Mr. Hugh McG. Ross, M.A., for his paper entitled "The Heating of Film and Slides in Projectors."

The Convention concluded with the Presidential Address of Dr. Leslie Knopp.

ORDINARY MEETING

The fifth Ordinary Meeting of the British Kinematograph Society was held on May 5, 1951. The President, Mr. A. W. Watkins, was in the Chair.

Minutes

The minutes of the Ordinary Meeting held on April 29, 1950, were read by the Secretary, Miss Joan Poynton, and were agreed.

Secretary's Report

The Secretary submitted her report as follows:—

This is the first Secretary's Report to be presented at an Ordinary Meeting of the Society and I have a deep sense of the privilege which is accorded me.

Whilst the past year has not lacked its disappointments, it has not been without its measure of achievement too, both in regard to the accepted activity of the Society and in the various experiments which have been carried out.

By experiments, I refer to the educational work which has been initiated. A second venture has been embarked upon in this field, after a short lapse, and the result has been encouraging.

Indeed, the result may be interpreted as a clear sign of the duty which lies ahead to provide facilities for those of our members who wish to make a study and develop their technique in the various branches of cinematography or its allied subjects.

The need for brevity enforces limitations in the following report, but I hope it may prove adequate to give you a fairly clear picture of events.

Membership.—In spite of the difficult position within the industry, it is encouraging that the intake of new members in the past year has been maintained at almost the same level as for the previous year.

If you compare the following figures with those of last year, you will notice that there is a decrease in the total of 79. This has come about because until December 31, 1950, there were

carried on the register a number of members who had not officially resigned from the Society, but who had not renewed their subscriptions—in some cases for as long a period as four years.

The newly constituted Membership Committee, under the chairmanship of the Vice-President, made it the first task to institute a detailed enquiry to find out the reason for these members allowing their subscriptions to fall into arrears. Subsequently, a number of them were expelled from the Society.

In the future, the case of any member whose subscription is in arrear for more than one year will be considered by the Membership Committee annually, and by this means the register of membership will be kept more up to date than has previously been the case.

The total number of registered members of all grades is:—

	1950	1951
Hon. Fellows, Fellows and Hon. Members	38	43
Corporate Members	643	625
Associates	407	357
Students	69	53
	<hr/> 1,157	<hr/> 1,078

The Society has sustained a sad loss in the deaths of both Mr. Simon Rowson, the first President of the Society, and Mr. Charles H. Champion. The late Mr. Rowson had not taken an active part in the Society's affairs for some years, but he was one of its original architects and did much towards laying the foundations upon which we are building to-day. Many will recall the generous practical assistance that the late Mr. Charles Champion gave in more recent times, and his untimely death in Belgium last year was a profound shock to all of us.

Patron Members.—The Patron Members have in the past year given their wholehearted support to the work of the Society.

The generous financial assistance given by the Patron Members, and the importance of their contribution to the Society's economy, should not be under-estimated. A debt of gratitude is owed to them for their practical encouragement and goodwill.

A number of new Patron Members have been enrolled during the past year.

Journal and Papers.—There has been great delay in the publication of the *Journal*, and a humble apology must be offered to our members for the inconvenience that has been caused. This is particularly pertinent to advertisers in *British Kinematography*. A deep appreciation is owed to those firms who have understood the difficulty and co-operated so generously.

By now you will have studied the new format of the *Journal*. It is hoped you will consider that it is an improvement and, while still dignified, more in keeping with the progressive outlook of a modern industry. You have received three issues from January to March, and by next month it is hoped that publication will be right up to date once more.

The attendances at the meetings at Film House have, on the whole, been fairly good. It would appear that the adoption of the principle that on the one hand papers must be constructive in their application to scientific, technical and allied matters, and on the other, that they open the door to the infinite possibilities of the future, has produced a basis upon which acceptable programmes may be planned.

Some of the subject matter of the papers has been of interest to other Societies, and joint meetings have therefore taken place with the British Film Academy; the Royal Photographic Society; the British Sound Recording Association; the Television Society and the Association of Cinematograph and Allied Technicians.

The Annual Studio Visit, which seems the most popular event of the year, took place last May at Ealing Studios, by courtesy of Major Baker and Sir Michael Balcon. A fine day produced a full attendance, and our thanks are due to the Management and Mr. Baynham Honri for his work in providing everyone with so memorable an occasion.

Education.—Three courses of instruction have taken place in the past year, two on "Lighting for Kinematography" and one on "Sensitometry."

The course on "Lighting for Kinematography," which commenced on October 23, 1950, took place at Ealing Studios. The number of applications for enrolment far exceeded the number of available places, and so a further course was arranged to commence on February 26 of this year. The course took place at the Colonial Film Unit

Theatre and, again, there was a full complement of enrolments.

The course on "Sensitometry" commenced on February 26 also, at Kay's (West End) Theatre. The number of enrolments it was possible to take was very limited, and it is clear that there is a case for a repeat course on this subject in the 1951-52 Session.

We are grateful to the management of Ealing Studios, Ltd., the Colonial Film Unit, and Kay's (West End) Laboratories, Ltd., for the assistance given and the accommodation made available to us. An expression of appreciation for the generous contribution they have made to the success of the courses is due to the Vice-President, Mr. Baynham Honri, and Mr. R. J. T. Brown, and also to the lecturers in the courses and the staffs of the respective studios and laboratory.

Last year, mention was made of the likelihood of the Society becoming the Examiner in connection with the Training Scheme for Projectionists sponsored by the Ministry of Labour, the Cinematograph Exhibitors' Association and the National Association of Theatrical and Kine. Employees. The scheme, which has been in abeyance for some time, is shortly to be implemented, and the Society is called upon to formulate the necessary standards for examination purposes.

The Library.—The Library at Piccadilly is something of which the Society may justly be proud. It is small, but reasonably comprehensive, and a number of new volumes has been added in the past year. There is a Librarian in attendance, who is happy to send books by post upon request, or to obtain any particular reference book that may be required.

Recently, the industrial shelves in which the books were contained have been replaced by dust-proof mahogany bookcases. These will prevent the deterioration of the books and they have greatly enhanced the appearance of the Library.

Members of the Library Committee, under the chairmanship of Mr. R. J. T. Brown, are to be congratulated on the happy results with which their labours have been rewarded.

Television.—The unknown element in the future relation of television to kinematography has occasioned some lengthy deliberations in recent months.

Steps have now been taken in conjunction with the Television Society to form a Kinematograph/Television Group, with the object of promoting the study and discussion of the joint application of television and kinematography for entertainment and educative purposes.

In broad principle, the proposals concerning the Group have been agreed. It will be self-governing and directed by a Committee representative of both the Societies. The membership will be limited to professional members in either industry.

Standardisation.—Members of the Society continue to give generously of their time and knowledge to serving on the main and technical committees of the British Standards Institution. The solid record of achievement of these committees is evidenced by the continuous forward motion of industrial standardisation, and a debt of gratitude is owed our members for the contribution they are making to industry and to the prestige of the Society.

The Divisions.—Reports on the work of the three Divisions have been made by the individual Chairmen, and it is necessary therefore to make only a brief reference to them.

The influence which the work carried out by the Divisions has on the policy of the Council has been frequently demonstrated in the past year.

Steps may be taken through the choice of papers and method of presentation to improve the economic position in the industry, or experiments made to find out the most popular days and times for meetings. A decision may be taken to change the name of a Division, or to institute a time-absorbing investigation.

Whatever the matter under review in the past twelve months, always it demonstrates a realistic and progressive outlook and redounds greatly to the credit and prestige of the Society.

The Sections.—The progress of the Sections in Manchester, Leeds and Newcastle has been hampered in the past year by lack of support among the members.

The Vice-President, Chairman of the Branches Committee and Mr. R. E. Pulman have, over a long period, made a careful study of the local conditions. It appears in each case that there is a nucleus of enthusiastic members who are anxious for some organised activity, but it remains for those stewards to encourage others to their ranks if the arrangement of programmes for the new Session is to be justified.

The Staff.—I would like to place on record my gratitude for the support I have received from the staff in the past year.

Miss Barlow is to be congratulated on maintaining the advertising revenue at so high a level, and Mr. Randall, the editorial assistant, on his general record of achievement, which should not be underestimated.

We have been fortunate in securing the part-time secretarial services of Mrs. McInnes Smith and Mrs. Preston, whose efficiency and loyalty have made them very welcome and a pleasure to work with.

Conclusion.—To conclude, there are two further matters to which I must refer.

Mr. John Abbott is an old friend of the Society, but his enthusiasm for its activities and his co-operation in carrying them out is always refreshing and of very high value to all of us.

Another good friend, though not such an old one, is Mrs. Steele, the Secretary of the British Film Academy, whose offices are on the same floor as our own. Mrs. Steele has on countless occasions assisted us in the most generous manner.

Hon. Treasurer's Report

The Hon. Treasurer submitted his report as follows:—

The accounts for the year ended December 31, 1950, show that the Society has weathered a very difficult year without being forced to restrict its activities. While some of the expenses are of a non-recurring nature, we shall nevertheless have to approach the coming year with extreme caution in view of the rapid increase of costs in all directions.

Income.—The subscriptions show a decrease on the previous year of approximately £400. This decrease was not entirely unexpected, in view of the difficulties in the industry, but it is heartening to note the increase of almost £200 in the Patron Members' donations. It is particularly gratifying to know that our Patron Members have confidence in the Society, and show this confidence in a tangible way. With the interest on our investments and other small items, our total income amounts to £3,196 compared with £3,535 for the previous year.

Expenditure.—It will be noted that the allocation of our expenditure has been modified slightly, and this accounts to some extent for the differences between some of this year's and last year's items. The main change we have made is to allocate salaries of those members of the staff who are directly associated with the Journal to the Journal's expenses, and not, as in the past, to General Expenses. It will be seen that the salary figure for the year is £1,410 as compared with £1,839 for the previous year. This is balanced by the Journal deficit of £562 this year, as compared with £143.

I would like to take this opportunity to refer to the Journal Account. The salary figure is £535, which is only a little less than the total deficit. This shows that, compared with the previous year, when salaries were not included in this account, the Journal deficit has been reduced, and this in spite of the increase in costs. I am afraid that it is unlikely that I will be able to say the same thing next year, because, as you have no doubt heard, the cost of newsprint has just been increased by about 40%, and this is going to be a serious problem which the new Council will have to face. I can, however, tell you, as Chairman of the Journal Sub-Committee, that every endeavour is being made to reduce the cost of the Journal without reducing its effective value to the members.

Reverting to the expenditure figures, it will be noted that our rent has increased by £165. This is, of course, because we are now fortunate enough to have premises much more suitable to a Society of our standing. I do not think that anyone can complain at this additional cost. Increases in telephone, stationery, postage, and meeting expenses are moderate. The figure for repairs and maintenance is a high one, but is due in the main to the costs involved in moving into and furnishing our new premises. This year we have an Advisory Accountancy charge, to which I will refer later. The other items are self-explanatory, and I do not think need any comment, with the exception of the figure of £25 for bad debts. These debts extend over a period of five years, and have in the past been carried forward. It has to be faced that we have no hope whatever of collecting them, and we have decided to write them off immediately. There are no large items, but a number of small accounts, some of which cover advertising charges in the Journal.

Referring again to the Advisory Accountancy charge, we have, as you know, been fortunate enough to have the services of Messrs. Finnie, Ross, Welch & Co. as our Auditors, and we have asked them to provide additional services, firstly in overhauling our book-keeping arrangements, and secondly, to look fully into our income tax problems. You will be pleased to know that our book-keeping methods were found to be sound, and it was only possible to make one or two slight modifications, with a view to saving labour in the office. With regard to the income tax demands which we have been facing, our Auditors have been able to obtain a measure of agreement with the Inspector of Taxes to the effect that any profit which may be made in one year can be carried forward against possible losses in any number of subsequent years. The only proviso is that the Society must not act in any way as a commercial concern out to make money—for example, selling our Journal at a substantial profit. This concession on the part of the Inspector of Taxes, who has made it in full appreciation of our position as a learned Society, is of great help to us, and has considerably reduced our deficit for the year just ended, and we owe our Auditors our deepest thanks for their endeavours on our behalf.

My final duty is to warn all members that we are facing a period when it will be increasingly difficult for us to carry on at the standard which we have maintained during the past few years. The help of members to ensure that our income does not decrease is the first and obvious requirement, but nevertheless we may have to economise in any of a number of ways during the times ahead of us. This is a problem which your Council will have to face, but I would be failing in my duty as Hon. Treasurer to the Society if I did

not draw attention to this state of affairs, which, I imagine, is being faced by all learned Societies.

Discussion

Mr. D. FORRESTER asked whether any details were available concerning the resignation of Mr. Rex B. Hartley as Hon. Secretary.

THE PRESIDENT said the Society had nothing to hide, but he did not consider it fair to give full details in Mr. Hartley's absence. It had been the unanimous decision of the Council, which consisted of gentlemen of integrity and great learning, that the ultimatum which had been received from Mr. Hartley could not be tolerated.

Mr. FORRESTER said he did not wish to question the decision of the Council.

Mr. P. W. DENNIS questioned the efficiency of the present staff of the Society.

Mr. D. FORRESTER drew attention to the excess of expenditure over income shown in the Income and Expenditure Account for the year ended December 31, 1950. He stated that he had made a suggestion to the Council which would cut expenses, but that this had been turned down.

THE PRESIDENT stated that he had not experienced the discourtesy mentioned by Mr. Dennis. In taking up Mr. Forrester's points, the President stated that the loss shown on the Income and Expenditure Account was a paper loss only. Mr. Forrester's suggestion, which had been considered by the Council, was turned down because it was felt that it was not in the Society's interests to be allied with a commercial organisation. Such an alliance would jeopardise the possibility of the Society receiving a Royal Charter.

Adoption of Reports

Mr. Baynham Honri proposed, and Mr. H. Waxman seconded, the adoption of the Secretary's report. Mr. S. A. Stevens proposed, and Mr. D. F. Cantlay seconded, the adoption of the Hon. Treasurer's report. Both proposals were carried unanimously.

Election of Officers and Council

The President announced that the following officers had been elected unopposed:—

President: Dr. L. KNOPP.

Hon. Treasurer: Mr. H. S. HIND.

The following had been appointed as scrutineers in the election of the Vice-President, the Hon. Secretary and members of the Council:—

Messrs. A. C. Snowden, D. F. Cantlay, H. W. Preston and W. S. Bland. Mr. D. F.

Cantlay, in his report, announced that the following had been elected:—

Vice-President: Mr. BAYNHAM HONRI.

Hon. Secretary: Mr. R. J. T. BROWN.

The members of the Council: Messrs. I. D. WRATTEN, R. E. PULMAN and Dr. F. S. HAWKINS.

A vote of thanks to the Scrutineers was proposed by the President and carried unanimously.

Appointment of Auditor

It was proposed by Mr. S. A. Stevens, seconded by Mr. D. F. Cantlay, and carried unanimously, that Messrs. Finnie, Ross, Welch & Company be appointed auditors for a further year.

President's Address

The President paid tribute to Mr. R. Howard Cricks, who had in the past been willing to serve the Society to the best of his ability as Editor of the Journal. The President wished him every success for the future and hoped that his health might improve from year to year.

In reviewing the present position regarding Television, the President stated that a decision had been taken at the last meeting of the Council to form a Group in conjunction with the Television Society which would operate for a preliminary period of one year. At the end of the year the

position would be reviewed and other steps be taken if necessary.

A course of lectures would be organised by the Standing Committee appointed to administer the Group.

Vote of Thanks

The President proposed a vote of thanks to the Gaumont-British Picture Corporation and Mr. J. S. Abbott, Hon. M.B.K.S., and his staff for the use of their theatres; to Ealing Studios, Ltd., and Mr. Baynham Honri for the use of their theatre; to the Colonial Film Unit and Mr. H. Davidson for the use of their theatre; to Kay's (West End) Laboratories, Ltd., and Mr. M. V. Hoare for the use of the West End theatre. Also included in the vote of thanks were the Patron Members, Journal Advertisers, and all members who had served on Committees, and the Trade Press for their reports of meetings. The resolution was carried unanimously.

Indian Visitor

The President drew attention to the fact that the Society's Indian representative, Mr. Y. A. Fazalbhoy, was attending the meeting. The President took the opportunity of welcoming Mr. Fazalbhoy on behalf of the Society.

NEWLY ELECTED HON. SECRETARY AND MEMBER OF COUNCIL

Mr. R. J. T. Brown was elected Hon. Secretary and Dr. F. S. Hawkins a member of the Council in 1951. A Photographic Technician of Ilford, Ltd., Cine Sales Department, he has rendered valuable service to the Society as Chairman of both the Papers and the Library Committees. Further reference to Dr. Hawkins, upon whom the Fellowship has been conferred, appears on page 7.

INDUSTRIAL TRAINING FILMS

The Scientific Film Association has published a 41-page index of films suitable for training in industry. The films cover a very wide field, and are classified under the U.D.C. system.



R. J. T. BROWN

PRESIDENTIAL ADDRESS

Leslie Knopp, Ph.D., M.Sc., F.I.E.S. (Fellow)

Presented to the British Kinematograph Society on May 5, 1951

WITH your permission, I do not propose to follow the tradition laid down for the Presidential Address of a learned body this evening, because I think there are matters of greater importance to which I should direct your attention.

During the last decade the British kinematograph industry has fallen from a high pitch of success into a trough of depression. Particularly recently there has been a severe economic crisis which has greatly affected the livelihood and well-being of our members, whilst the industry as a whole has suffered from the internal warfare which such crises often promote. These difficulties have reached governmental level and are common knowledge to the general public.

The primary object of our Society is to encourage the scientific and technical aspects of cinematography and its allied arts and sciences, but we can quite properly analyse the economic, commercial and political situation of our industry without forsaking that neutrality and impartiality of which we are proud. We can only do this if we are objective in our analysis, reaching our conclusions with a cold logic of enquiry.

Historical Aspects

We must first consider the economic history of our industry. In its early days commercial relationships were of the simplest kind. The film producer was at first his own exhibitor and what he earned from the public was his. Soon the producers were devoting the whole of their time to making films and the copies were sold outright. Both producer and exhibitor benefited by this arrangement. Production costs were low, but some exhibitors found it advantageous to show their purchased copies at several of their kinemas. In other words, they circulated their films around their cinemas, hence the term "circuit." This occurred both here and in America. Here we had the Pyke Circuit,

built by Montague Pyke, and in America we had the Nickelodeon Circuit, very similar in general basis.

The financial success of both producers and exhibitors was promptly recognised by opportunists, ever willing to make money quickly, and kinemas began everywhere to spring up in shops, restaurants and all kinds of halls. Growth was entirely indiscriminating and the more seriously-minded exhibitors united for mutual protection. Producers discontinued the outright sale of films and adopted a hiring policy on a flat-rate basis. This hiring of films considerably widened the producers' market and American and Continental films were sent here and our films found their way abroad.

Early Trade Practices

In about 1908, trade practices were being developed. The producers and exhibitors were oppositely aligning themselves into strong trading groups to control the market. In that year, for instance, the Congress of Film Producers agreed to withhold films from small cafés and restaurants which did not charge for admission, and the Motion Picture Patents Company was formed to restrict the supply of raw stock to its own members. Two years later, however, the Eastman-Brulatour deal made film stock available to independent producers, which gave fresh impetus to film production, and there was a large increase in the number of films made. This produced a buyers' market and exhibitors could pick and choose and, with such competition, they were able to drive very hard bargains.

Because of the need for an organisation to look after the complicated business of distributing a large number of films among an equally large number of kinemas within a short space of time, film renters and distributors entered the field as middle-men. Some producers created their own renting organisations, notably in the U.S.A., where Para-

mount were the leaders. In this country, the British and Colonial Kinematograph Company created its own renting organisation.

The early renters introduced two innovations in order to weaken the exhibitors' bargaining position. The first was the trade show, which had as its object the showing of the best film in the bag. This was used as the bargaining plank for the second innovation, the blind, block booking scheme of a number of inferior films. These practices, however, did not materially weaken the exhibitor's position, since he could offset one block against another in the same way as he had offset one film against another.

Many of the better British and Colonial producer/distributors, such as Hepworth and Barker, and the British Colonial Film Company, however, were able to make good quality films and to demand a good price for their products. Indeed, English films from these studios were, in every respect, the best in the world.

First World War

With the first world war, this supremacy was lost. There was almost a cessation of film production in the United Kingdom. America grasped the opportunity offered and she has since been able to retain that advantage. Until 1930, therefore, the development of the home industry was predominantly the history of the American film industry. In America, exhibitors were forming trade blocks to maintain their bargaining position, and the larger producers began to build their own kinemas in order to find an outlet. Foremost among these were Paramount, who, until recently, owned 1,400 kinemas.

This buying war reached its peak in 1928, when these producer-exhibitor groups had to seek the assistance of financiers and bankers. In 1932 there was, to some extent, a breakdown in these producer-exhibitor groups because the public did not like the similarity of programmes which necessarily characterised these tied houses. The opposition to independent producers relaxed and there was a growth in their number. To preserve a measure of stability, the American industry

was placed under the N.R.A. Code of Fair Trade Practices.

Post-War Period

After the first world war, we in the British Isles were more interested in reconstruction than in exploiting films, and exhibitors had to rely upon America for programmes, although a few bold individuals began production under the greatest of difficulties and with very slender financial resources. Americans had realised that a vast sum of money spent on one film brought great rewards provided that it had access to foreign markets. The British films lacked this splendour and magnificence and found it difficult to get an adequate showing even in this country.

The tide began to turn in 1925, when fixed quotas were introduced and it was compulsory for British exhibitors to show a proportion of British films. With the introduction of the British Film Act in 1927, some of the producers got a much firmer hold, notably British International, British Instructional and Gainsborough.

The 1927 Quota Act also relieved exhibitors from the blind block booking which they found so onerous; but was not a complete success because, with its inadequate financial support, the British film reached no higher level than the less ambitious productions from America.

This Quota Act, too, enabled the less highly principled producer to make snap profits by producing the infamous "Quota Quickie," which did inestimable damage to the British film production industry.

America, foreseeing that British producers might become formidable competitors, built studios over here and made films which were regarded as British for Quota Act purposes.

At this time, the industry in this country was an echo of what already had happened in America. Kinema circuits were being built up and we had introduced the producer-exhibitor combines like Gaumont-British, who had built Lime Grove Studios and had combined with Gainsborough and Islington Studios. On the exhibiting side, they had amalgamated several large exhibitor circuits

and a large number of smaller exhibiting companies.

Introduction of Sound Film

In 1928 to 1929, the sound film was introduced and a great change occurred. Exhibitors scrambled to re-equip their kinemas and urgently demanded more and more sound films. The installation of sound recording equipment, the acoustic treatment of studios and all the other ancillary equipment demanded exceptionally heavy capital expenditure which only the strongest producing companies could bear. The result was that a large number of small independent producers, both here and in America, went out of business.

The consequence was a complete reversal of the trading positions. Sound films were in short supply and renters could demand very high prices and they were able to establish a new system of trading whereby the payment of film hire was by a percentage of the box office takings. This system of trading has continued until to-day.

Shortly after the first Quota Act and the introduction of the sound film, the industry received a very severe setback. There was a world-wide depression and the cinematograph industry everywhere reached a very low ebb which lasted for two years.

Exhibitors felt the first benefits of the subsequent revival. In 1934, great sums were spent in modernising kinemas, and by 1936 this side of the industry had completely recovered. There was widespread building of new kinemas and a very considerable circuit expansion, probably inspired by a desire to strengthen the exhibitors' bargaining position with the renters who had still retained their superior position.

The independent exhibitors were against this circuit expansion, because they saw their own position being still further weakened by the struggle of the giants, and they tried to restrain the circuits from entering new territory.

The British film producer did not recover from the trade depression so quickly if, indeed, he did recover at all. Despite the protection of the Quota Act, he could not

secure a satisfactory return. Even the producer-exhibitor monopolies were losing money heavily.

The British producer continued to imitate the American pattern but, if the films were cheaply made, they lacked public support and if they were more pretentious the income was insufficient to meet production costs. It was necessary to enjoy a world market in order to gain a fair return. Although it would be a simple matter to name several British films that were financially successful despite the restricted market, this does not disprove the generality—rather does it show that the producers of these exceptional films did not reap their full harvest.

This period saw a further change in commercial relationship. The film producer could not recover from trade depression and desperately needed money and the renters became the financial sponsors of the producers. This practice continues to-day. The extent of the support varies from 50% to 100% of the production costs and the average of 75% is common to-day.

American Supremacy

The decade before the second world war saw the British production industry in a very weak condition and the American producer and distributor still dominating the world market. British exhibitors were in a state of satisfactory stability. The circuits kept any too-demanding tendencies of producer-renter in check and the independent exhibitor, often at variance with the circuits in domestic matters, gained considerably from their strength.

The 1939-45 war had a less disastrous effect upon the cinematograph industry, and although producers were curtailed in their activities there was a steady demand for British films.

The exhibitors did record business but the war witnessed a sharp increase in costs although, due to this record business, the exhibitor did not increase admission prices. This was unfortunate, because it enabled the Chancellor of the Exchequer greatly to increase entertainments taxes, causing the

gross admission prices to reflect the general increase in the cost of living.

Duty on Foreign Films

British film production launched forth in the full flush of victory in 1945-46. Large sums of money were being speculated by producer-renter combines, banking groups and financiers, and films of considerable magnitude were made. Sums so large were spent on individual productions that the home market could not cover their cost. Producers also found that our erstwhile allies had again closed the foreign markets to them.

The Government now introduced the 75% *ad valorem* duty on foreign films.

American Embargo

The American producer-renters acted quickly; knowing that British production, at full capacity, could not produce sufficient films to keep open our 5,000 cinemas, they promptly cut off all supplies of new films. Some British producers foresaw a golden opportunity for British film production but, in fact, this tax caused apprehensions in the City as to the outlet of British films, and showed how essential was the maintenance of the present number of cinemas if production costs were to be recovered by the backers. The *ad valorem* duty was withdrawn after nine months and the Government introduced the new 45% Quota with the object of restoring confidence in British film production. It is a deplorable commentary that within six months it had the opposite effect.

National Films Finance Corporation

Financiers had lost confidence and money could not be found to support producers. But money had to be found if British production were not to close down altogether, and this was only prevented by the Cinematograph Films Production Special Loans Bill introduced in November, 1948. This provided for the formation of a National Films Finance Corporation with a fund of some £5,000,000 to be loaned to producers. This was only a temporary stopgap. Indeed, the Corporation said in its first report, "what-

ever the Corporation may be able to do, its financial operation could not be more than a measure of expediency. The lending of money will not bridge the gap between income and expenditure" in British film production.

At the introduction of the 45% Quota, the Americans again retaliated. A unit plan was introduced whereby only all-American programmes could be booked.

British producers had hitherto specialised in first feature films and there were insufficient British second feature films available, and thus, if two British films were shown together in one programme, their potential income was halved.

Furthermore, nobody would expect every British film to be a winner but, by coupling one of the less successful British films with a suitable American second feature, a programme could make the grade with satisfactory results to all concerned.

Unfortunately, sufficient films could not be made to meet the 45% Quota, despite the assistance of the Finance Corporation, and the Quota was lowered. Despite further grants of money, the number of British films declined and the figure was still further reduced. This has produced bitter battles between exhibitor and producer, the producers maintaining that if an exhibitor consistently failed in his Quota obligations, his licence should be withdrawn and he should be deprived of his livelihood.

A single British film shown three or four times in one town cannot possibly make money, and until enough good British pictures are produced the system is impracticable and meaningless. Even the producer-exhibitor combines have been unable to fulfil the Quota obligations.

Government Committees

In 1948 and 1949, the Government set up several committees to investigate the problems of the trade, the Film Studio Committee, the Working Party of Film Production Costs and one on the Distribution and Exhibition of Films. Despite all, the Films Council reports: "The difficulties of the British film industry have continued and its

fundamental economic problems seem unfortunately no nearer solution. This state of affairs cannot continue indefinitely and if British film production is to survive on the scale which we all believe to be desirable, energetic measures must be taken forthwith to put the industry on a sounder economic basis."

Thus, the economic picture of the industry over these last few years is an unhappy one. The value of the shares of our public companies—producers and exhibitors together—has fallen by £51,000,000 since 1948. This is the measure of the loss of confidence of the Stock Exchange and the investing public.

The patronage of cinemas has also fallen; the gross takings of £115,000,000 in 1947 had fallen to £105,000,000 in 1949 and estimates for 1950 foretell the takings to be £102,000,000. Thus there has been a fall of £13,000,000 per annum in box office takings.

The employment in studios has fallen from 7,250 in 1948 to 4,100 in 1950—a drop of 3,100: 43% of our colleagues in film production are out of employment.

Every section of the industry has experienced substantial increases in working costs and serious decreases in income. Each wants more money and each blames the other for taking too big a share.

The position in America was, until recently, very similar, and the producer-renter-exhibitor combines had almost complete control. But these combinations have been brought within the ambit of the anti-trust laws of that country and after twelve years the Supreme Court of Appeal has refused to review the decision of the Lower Statutory Court. This decision will cause a new set-up in the industry in America.

It is not possible to say what will be the effect of this major alteration, this divorce-ment, in the American political and economical scene. It must be remembered that American production has experienced lean times and in both countries it has been between the independent producer and the independent exhibitor that the battle has been fiercest.

Expenditure of Present Income

Let us see how the present income of the industry is expended compared with that of 1939.

In round figures, the gross box office receipts in this country have increased from £47,000,000 in 1939 to £102,000,000 in 1950, representing an increase of 118%. This would, at first sight, appear more or less satisfactory, although it is rather less than the general increase of incomes of other industries.

But Entertainments Tax has increased from £5,620,000 in 1939 to £43,230,000 in 1950—an increase of no less than 672%. Thus the net income has only increased from £42,000,000 in 1939 to £59,000,000 in 1950—an increase of only 40%.

How has this small increase of 40% been expended by the cinema exhibitor? He has experienced in common with all other industries very substantial increases in costs. Film hire cost has increased by 81%; wages and salaries of cinema staffs by 144%; running expenses by 73%. Thus the balance for depreciation, obsolescence and profit is very slender—indeed, many small independent exhibitors are able to carry on only by making no allowance for depreciation and the replacement of equipment or, indeed, repairs and decorations to buildings.

From details received from a large number of cinemas, the division of the gross box office takings for 1950 was:—

Entertainments Tax	37.5%
Film Hire	25.2%
Wages and salaries	15.3%
Electricity, rent, running costs ...	19.1%
Depreciation, repairs, obsolescence and profit	2.9%

These figures require a slight adjustment because last August there was a further increase in the Entertainments Tax and the introduction of the Eady scheme, which has not been running long enough to include in the above table.

The cost of film production has similarly increased: wages and salaries have increased by 158%, sets and production work by 115%, hire of equipment, studio rents and general sundries by 96%.

The problem of the trade is therefore simply stated: our net income has since 1939 increased by 40%, but our expenditure and commitments have increased by over 150%. What is involved in bridging this gap?

Sir Michael Balcon has recently pointed out that a carefully produced and economical British picture costs £150,000: and if we allow a modest profit of 10% (and this is modest, because picture making is a very speculative business) the producer should get £165,000.

To this must be added the cost of release prints, advertising and distributor's costs, which represents 20%, bringing the required gross for the film to £188,000.

From the Plant Committee's report we learn that 1/9th of this amount must be added for supporting items, shorts, etc., bringing the cost of a single programme to £209,000.

To fulfil a 40% Quota, 110 British programmes are necessary. Thus the gross income to the producer-distributor side of the industry should be £23,000,000. According to the Plant Report for the year 1948, the distributors' gross receipts were £11,000,000 for British films and, since that date, they have probably fallen to about £9,000,000. Thus, for every £1 received by the British film producer, the Chancellor extracts £4 from the industry.

The effect of the Eady scheme is likely to raise this income to £10,500,000 for the year ending August, 1951. To bridge the gap between the present £10,500,000 and the required income of £23,000,000, an additional £12,500,000 per annum is necessary.

The Chancellor now proposes a further increase in Entertainment Tax of 2d. per seat, and to aid the industry he proposed to give it a halfpenny per seat. This seems to be some sort of Draculean blood transfusion where the surgeon consumes three-parts of the blood, and the blood donor is already getting anæmic.

The increases in admission prices are likely to reduce the number of admissions and thereby reduce our income. A farthing per seat allocated to British production will produce little more than £1,000,000.

Needs of British Production

If British production is to be supported by the home market, it requires another £12,500,000 per annum to fulfil its obligations, to cover the cost of production and to make a reasonable profit. The exhibitors require an additional £4 to £5 million per annum at least to put them on a sound foundation, and both producers and exhibitors are facing rising costs and demands for higher wages to meet the spiral of the inflated cost of living.

If, as the Film Council has said, the film industry must be put on a sound economic basis and film production is to be supported by the home market, then at least a sum equal to 40% of the Entertainments Tax must go back into the industry. Thus, of the £45,000,000 which the Chancellor extracts from the industry in Entertainments Tax, £17½ to £18½ million is required to put the industry on its feet.

I say in all sincerity and seriousness that this money which is being directed from the industry is its life-blood.

The resources that are left are slender—they may last a year or two, but every passing month will make survival more difficult—and if this life-blood is withheld for long there will be no alternative: the British film industry is likely to wither and die or, at most, it will eke out a precarious existence.

The Society's Place in the Industry

We in the B.K.S. are concerned that the very great technical achievements and revolutions in technique in the last decades, in many of which our members have played a notable part, are being set to naught by economic and political crises.

I do not think that I can end this Presidential Address on this note. Although our Society can do nothing to alter these great political and economic forces, we can nevertheless play our part, and that part is to seek by all means the technical advancement of British cinematography. Each individual member can play his part, constantly and energetically to apply himself to his task, to give of his best and then, come what may, we can at least declare that if we did not command success, at least we did deserve it.

THE MAGNETIC RECORDING AND REPRODUCING EQUIPMENT FOR THE TELEKINEMA

G. F. Dutton, Ph.D., D.I.C.*

THE equipment supplied by "His Master's Voice" is designed for use with standard 35 mm. perforated oxide coated film. The film is coated over the whole of the surface on one side and the four tracks shown in Figure 1 merely indicate the tracks recorded by the four recording heads, necessary for the production of stereophonic and panoramic sound effects.

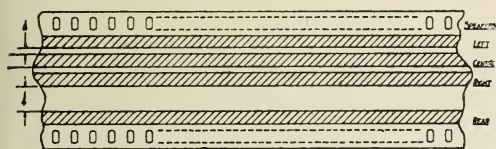


FIG. 1

Considerable development work was carried out to obtain the necessary uniformity of coating and choice of film base to meet the exacting demands of this equipment for the smooth running of the tape over the four sets of heads. Eventually, in order to meet the dimensional stability of the film and also

the uniformity of spread, high grade 5 thou. tri-acetate film was used. The thickness of the oxide coating spread on this film is .0005 inch \pm .00005 inch. Even with this careful choice of film base and even spread and equally careful choice of compatibility in the lacquer of the oxide coating, it was found necessary to use pressure pads on the heads, as shown in a later paragraph.

The four tracks are recorded simultaneously side by side as shown in Fig. 1,

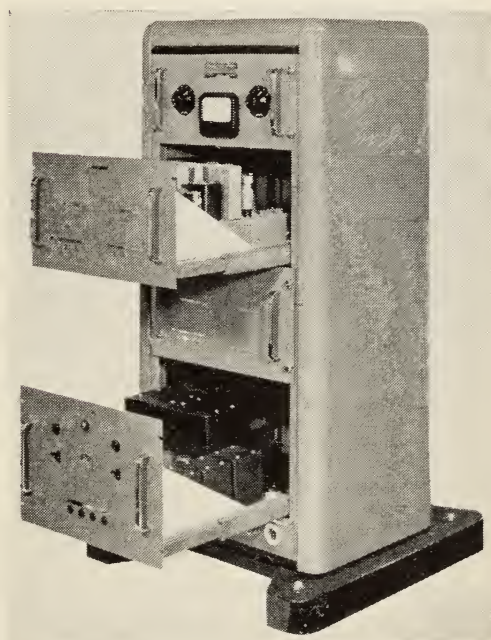


FIG. 3

each track being about $\frac{1}{8}$ inch wide (cross-talk between adjacent tracks being better than 36 dB), and run synchronously with the picture.

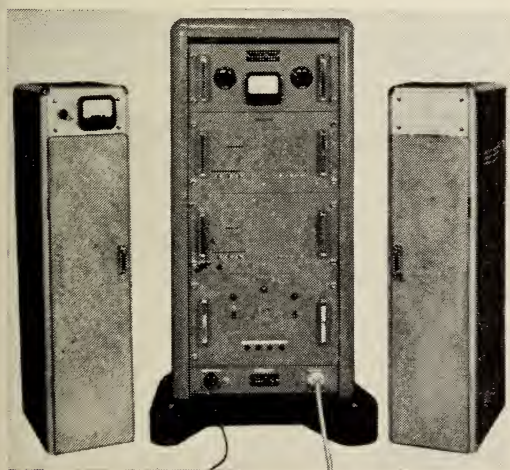


FIG. 2

* E.M.I. Engineering Developments, Ltd.

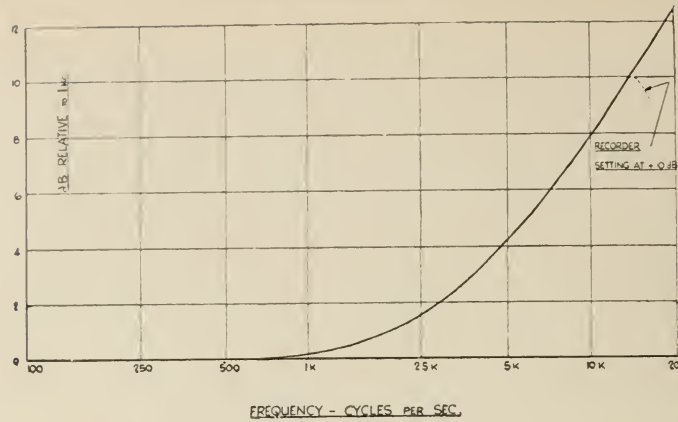


FIG. 4

Fig. 2 shows the recording and replay equipment, the latter being housed in two cubicles of dimensions decided by the projection room layout.

Recorder Cubicle

The recorder cubicle shown in Fig. 3 houses four separate record amplifiers which are, essentially, constant current devices supplying the individual record heads. Each amplifier is designed to load from a balanced 600 ohm line, zero level being 1 mW. The amplifiers are capable of recording peak level (+10 dBm) with a total harmonic distortion content (bandwidth 50 c/s. to 15 Kc/s.) of less than 0.25%.

The recorders deviate from "constant current" at the high frequencies to correct

the basic magnetic tape characteristics, and pre-emphasis is applied to a law 40 μ S (Fig.4).

Fig. 5 shows the circuit diagram of one channel. A point of interest to note is the use of parallel T feedback circuits to obtain the necessary adjustment in the recording characteristic and the use of suitable feedback in the output valve of the recorder to simulate a constant current generator. The filter in the output circuit prevents high frequency bias energy getting into the amplifier system.

Associated with each recorder is a supersonic erase and bias signal. This is generated by a resistance stabilised master oscillator which drives the buffer stages in each unit, the frequency being 65 Kc/s.

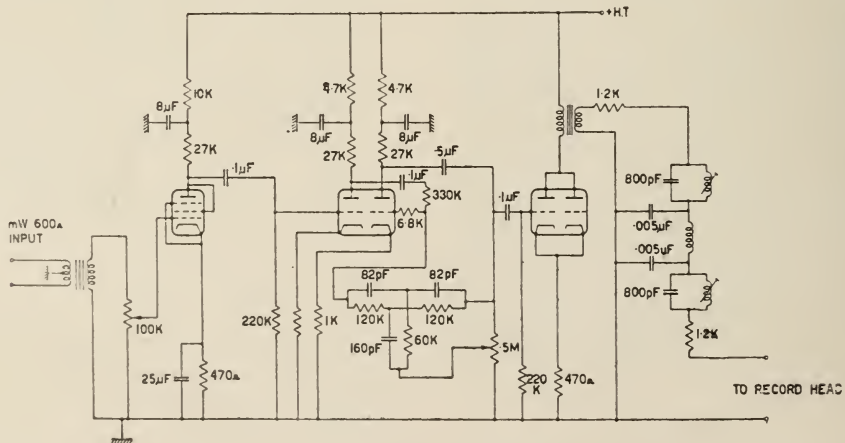


FIG. 5

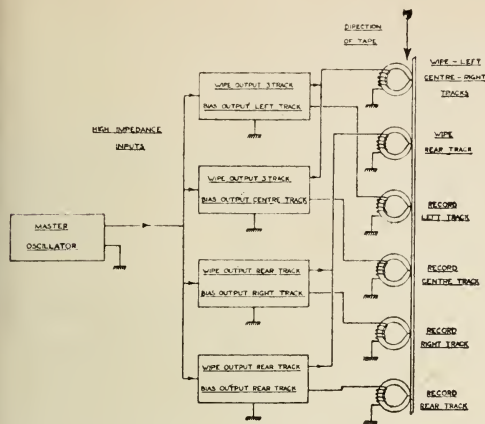


FIG. 6

Fig. 6 shows the arrangement of the oscillator and wipe heads.

Head Block Assembly

The erase, record and replay heads are assembled as shown in Fig. 7, the arrow indicating the direction of motion of the tape, which runs at 18 ins./second.

The erase or wipe head demagnetises the tape in preparation for recording. The two assemblies of record heads are made up of two heads each, one being responsible for tracks "A" and "C," and the other for tracks "B" and "D." Similarly the two assemblies of replay heads are made up of two heads each, corresponding to the record assemblies "A" and "C," "B" and "D."

Light pressure pads are fitted to each of the record and replay heads to ensure that the tape is kept in contact with the heads, as mentioned above. Fig. 8 shows a section of one of the head assemblies.

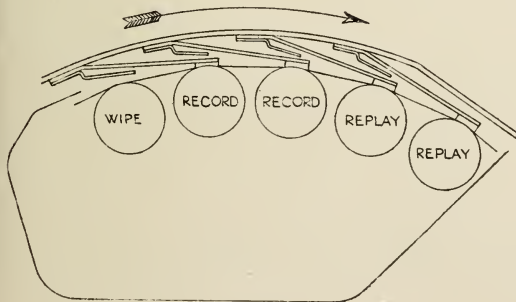


FIG. 7

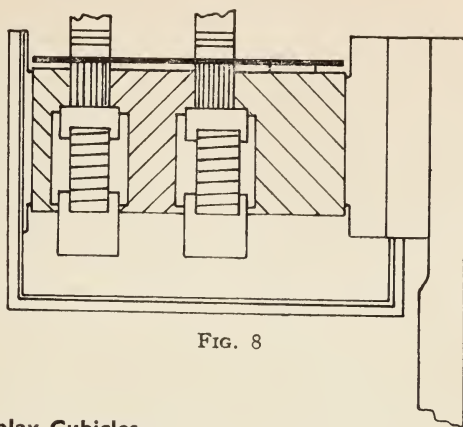


FIG. 8

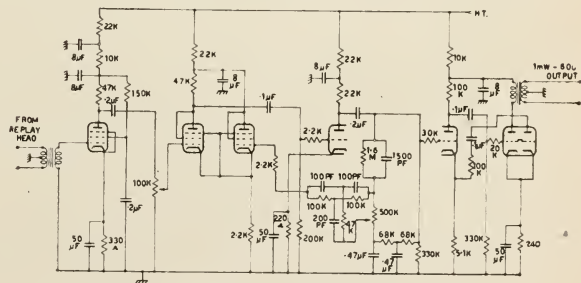
Replay Cubicles

The replay equipment consists of two sets of 4-channel replay amplifiers with equalisers, which accept the signals from each of the four replay heads, at a mean level of approximately 250 μV at 1,000 c/s, and amplify and equalise to give a mean output of 1 mW in 600 ohms, flat to within ± 1 dB from 50 c/s to 15,000 c/s. At this level the signal is fed over balanced lines to power amplifiers.

Fig. 9 shows the circuit diagram of one channel of the replay amplifiers, which, in view of the small signal being applied and the nature of the equaliser characteristic, are designed around special low noise valves and components.

Fig. 10 shows this equaliser characteristic which in effect provides a fixed boost at 6 dB/octave between approximately 2,000 c/s and 40 c/s and a variable boost of high frequencies between 5 and 15 Kc/s according to requirements.

The overall characteristic is, however, flat to the limits ± 2 dB 50 c/s to 15,000 c/s with the boost in the zero on normal setting.



REPLAY AMPLIFIER CIRCUIT DIAGRAM

FIG. 9

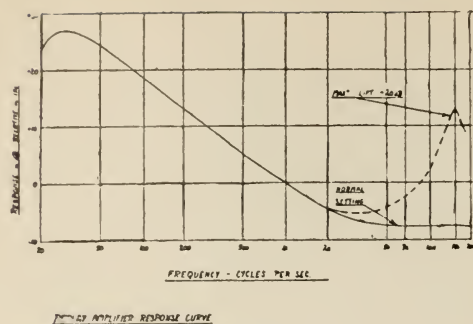


FIG. 10

Under these conditions of setting the signal to noise ratio for 2% r.m.s. peak distortion is better than 50 dB unweighted.

INTERVAL MUSIC EQUIPMENT

Interval music is provided from standard $\frac{1}{4}$ inch tape reproducers (Fig 11) running at 30 ins./second and having overall frequency responses within ± 2 dB from 30 c/s to 12,000 c/s with signal to noise ratio (unweighted) 56 dB for 2% r.m.s. distortion.

Two machines are arranged with a common control panel, one as a "Main" and the other as a "Standby."

The equipment is fully independent of all the other projection room equipment and is so arranged by relays that in the event of

failure of any other equipment, the interval music machines are able to supply programmes continuously.

FIG. 11



TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

MOTION PICTURE STUDIO USE OF MAGNETIC RECORDING

Loren L. Ryder, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 60.

A new system for operating magnetic recording equipment in the studios and the experience gained with it is described. The over-all procedure involves the use of a suitcase production recording channel using 17.5 mm. magnetic film, transferring the good takes to direct-positive photographic film for editing, and an edge numbering device for identifying and synchronising the film. 35 mm. magnetic film is used for dubbing and scoring and all transfers after completion of the takings are generally made from magnetic to magnetic film. A complete change in technique is involved and the results obtained have been very gratifying.

O. K. K.

ADVANCES IN COLOUR

R. H. Cricks, *Kine. Weekly*, Dec. 14, 1950, p. 61.

A modification of the Technicolor process makes it possible to film at a lighting level equivalent to that used for black-and-white. In the Alfacolor process, a black-and-white print on duplited stock undergoes re-sensitisation, bleaching, re-exposure, and then colour development, on one side to blue, and on the other side first to red, then yellow.

AUTHOR'S ABSTRACT.

HIGH-SPEED PHOTOGRAPHY IN TRANSONIC WIND TUNNEL

E. R. Hinz, C. A. Main and Elinor P. Muhl, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 613.

A description of the use of the Marley high-speed camera to film objects in a wind tunnel, at speed of up to 100,000 frames per second. The camera (made by C. F. Palmer, Ltd., of London) is described and illustrated.

R. H. C.

U.S. NAVAL UNDERWATER CINEMATOGRAPHY TECHNIQUES

R. R. Conger, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 627.

A favourable account of the use by the U.S. Navy of the Eclair "Aquaflex" under-water camera.

R. H. C.

MOTION PICTURES AND TELEVISION

V. K. Zworykin, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 562.

This is the paper read by Dr. Zworykin to the S.M.P.T.E. Convention in September, 1950, in which he parallels the development of colour in television with its earlier development in cinematography.

He deplores the fact that in certain steps in the advancement of television the experience gained in the earlier days of motion pictures had not been taken into account, but he is confused in thinking the path blazed by the motion picture industry is applicable to the television industry.

T. M. C. L.

MOTION PICTURE PRODUCTION FOR TELEVISION

Jerry Fairbanks, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 567.

This is a practical description of the cameras and studio set-up for cutting the production costs of motion picture films which are being made for television purposes. This technique uses three or more cameras simultaneously with different angles for long, medium and close-up shots. A synchronising device marks the film and sound track when change-overs are made between shots. With this process it is possible to film completely a 30-minute programme in one day and to film "live" shots as they are televised.

T. M. C. L.

LIGHTING METHODS FOR TELEVISION STUDIOS

H. M. Gurin, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 576.

This is yet another article relating the lighting conditions in a television studio with the sensitivity and other peculiarities of television cameras. It is particularly concerned with the new type No. 5820 image orthicon tube. In the article are described the new type of lighting fittings used in the N.B.C. Studio in New York.

T. M. C. L.

TECHNICOLOR'S LOW LIGHT LEVEL SYSTEM

Leigh Allen, *Amer. Cine.*, Dec., 1950, pp. 414 and 424.

Five studios in Hollywood have tested the new low light level system of Technicolor. Among the photographers responsible for the tests were Charles Rosher, of M.G.M., Arthur Arling, of 20th Century Fox, and Charles Boyle, of Universal-International.

This report states that the initial photographic research on the system began at M.G.M., under the direction of John Arnold. The purpose of the research was to "explore the possibilities of materially reducing photographing costs when filming in color, a substantial item of which involves the lighting and set operation time required to place the great number of lighting units normally used."

Established Technicolor lighting practice in America involved a working illumination from arc-lights of between 400 and 500 foot candles.

The principal aim in the beginning was to develop a system that would enable studios to photograph Technicolor interiors with unfiltered incandescent light instead of arc-light. This requirement led to a revision in the emulsion characteristics of the Technicolor "three-strip" combination, which change in turn demanded an alteration in the reflection/transmission factors of the camera prism.

Using the new stock and the new prism, a wide variety of scenes have been photographed at key light levels of 150 foot candles down to only 30 foot candles, and "at all times the illumination is adequate."

When arcs are used together with unfiltered incandescent lamps with the new system, the arcs will need filtering with the equivalent of two No. 84's and one No. 62. The light loss by reason of the filters is approximately 40%.

It is stated that the new system will be generally available to producers in America within four to six months.

J. H. C.

35 MM. ANSCO COLOR THEATRE PRINTS FROM 16 MM. KODACHROME

Adrian Mosse and Linwood Dunn, *J. Soc. Mot. Pic. & Tel. Eng.*, Dec., 1950, p. 635.

This paper describes the procedure followed by Filmeffects, of Hollywood, in producing 35 mm. Ansco Color release prints from 16 mm. Kodachrome originals.

Eastman Kodak's 16 mm. Commercial Kodachrome is used as the original camera film, and after editing with the aid of a 35 mm. black-and-white print, enlarged from a contact dupe negative made from the original, the 35 mm. release prints are printed on an Acme-Dunn optical printer using Ansco Color Type 732 stock.

Sound is added to the print from a 35 mm. positive image used in the negative position—the positive generally being obtained by re-recording to a direct positive.

The exposed Ansco Color is processed in the Houston Laboratories, where the sound track area is sulphide treated.

J. H. C.

THE COUNCIL

Summary of meeting held on Wednesday, June 6, 1951, at 117 Piccadilly, W.1

Present : Mr. L. Knopp (*President*) in the Chair, and Messrs. A. W. Watkins (*Past President*), B. Honri (*Vice-President*), R. J. T. Brown (*Hon. Secretary*), H. S. Hind (*Hon. Treasurer*), D. Cantlay, F. S. Hawkins, R. E. Pulman and S. A. Stevens.

In Attendance : Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. F. G. Gunn, T. W. Howard, N. Leever and E. Oram.

Fifth Ordinary Meeting.—The President has personally investigated the complaints made by Mr. P. W. Dennis and Mr. G. H. Sewell at the Ordinary Meeting of the Society. A misunderstanding was largely responsible for the charges made, and the matter had now been satisfactorily settled.

Policy and Administration.—The article by Mr. R. Howard Cricks in the "Kinematograph Weekly" of May 17 has been brought to the notice of the Council.

Mr. Cricks has for some time found himself unable to accept the Council's jurisdiction on policy and administration in the Society's affairs, and after serious deliberations extending over several months it is decided that the interests of the Society will be best served by asking him to tender his resignation.

It is confirmed that Mr. Cricks' services will terminate at June 30, 1951.

Public Relations.—In regard to Mr. Cricks' statement in the "Kinematograph Weekly" dated May 17, that other members of the Trade Press had been treated with discourtesy, the following extracts of letters received from the Editors of the other two Trade Journals are self-explanatory:—

"I very much took exception to his remarks about the trade press being subject to discourtesy, because I cannot recall any instance in which this paper has suffered in any such way in its various contacts with the Society."

"You surprise me in fact by your enquiry, for it is our experience we have had nothing but courtesy over the many years that we have been dealing with the Society, and certainly had no complaints."

Officers and Members of Council.—The Officers and Members of the Council for the forthcoming year are as follows:—

Officers.—President: Mr. Leslie Knopp.

Vice-President: Mr. Baynham Honri.

Past President: Mr. A. W. Watkins.

Hon. Secretary: Mr. R. J. T. Brown.

Hon. Treasurer: Mr. H. S. Hind.

Council: Mr. D. F. Cantlay, Mr. F. G. Gunn, Dr. F. S. Hawkins, Mr. T. W. Howard, Mr. N. Leever, Mr. E. Oram, Mr. R. E. Pulman, Mr. S. A. Stevens and Mr. I. D. Wratten.

Deputy Vice-President and Hon. Treasurer.—Mr. H. S. Hind is appointed Deputy Vice-President of the Society. In accepting the office, the Hon. Treasurership falls vacant, and it is hoped that Mr. N. Leever will accept this office until the 1952 election.

Kine/Television Group.—The Society's representatives on the Standing Committee to administer the Kine/Television Group are: Messrs. G. Burgess, W. Cheevers, M. F. Cooper and R. E. Pulman.

Newman Memorial Award.—The Society's representatives appointed to serve on the Joint B.K.S./R.P.S. Committee to determine a recipient for the Newman Memorial Award are: Messrs. B. Honri, L. Knopp, R. E. Pulman and A. W. Watkins.

The Award is made annually in recognition of outstanding invention or development of a mechanical nature in the sphere of either photography or cinematography.

National Film Library.—Mr. R. J. T. Brown is appointed the Society's representative on the National Film Library Committee.

The proceedings then terminated.

IMPORTANT NOTICE

The attention of members is drawn to the fact that the Society's offices will be closed from Saturday, August 11th, 1951, to Monday, August 27th, 1951, for staff holidays.

PERSONAL ANNOUNCEMENT

Wanted, Photographic Lens Designer experienced in high quality photographic objective development and design. Permanent position. Attractive salary. Moving expense will be paid. Farrand Optical Co., Inc., 4401, Bronx Blvd., New York, 70, N.Y., U.S.A.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than situations Vacant, not accepted.

BRITISH KINEMATOGRAPHY

VOLUME 19, No. 2

AUGUST, 1951

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THE KINE-TELEVISION GROUP

WHATEVER the outcome of various discussions which are taking place, there is no doubt that the future will see a much closer linking of the kinema and television interests. It is for this reason that your Council has wisely decided to anticipate developments and inaugurate the Kine-Television Group.

In this Group, those members whose work is mainly concerned with the projection of pictures from film will acquire knowledge of the projection from a cathode ray tube and its attendant apparatus. The projection engineer who is already fully occupied in keeping himself up-to-date on the advances in his equipment may well ask whether he is now to take on another subject with all the ramifications which its association with radio implies. Fortunately it will not be necessary at this stage to acquire a thorough

knowledge of telecommunication theory, but there are several practical applications that will have to be mastered if he is to become familiar with both film and television projection.

A series of introductory lectures will be arranged to give this necessary insight into the working of television reception and projection, and the syllabus will be carefully chosen to avoid any tedious theory or unnecessary detail. Particulars of these lectures will be given in a few months.

In the meantime, the Television Society, which has always worked in close harmony with the B.K.S., extends a cordial invitation to members to attend any of their meetings next session and find for themselves what is implied in this new form of entertainment.

G. PARR. (Fellow).*

(* Note : G. Parr is Hon. Secretary of the Television Society.)

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TELEVISION IMAGE KINEMATOGRAPHY

W. D. Kemp, B.Sc., A.M.I.E.E.*

Read to a Joint Meeting of the British Kinematograph Society and the Royal Photographic Society on February 14, 1951

THE photographing of television images for the purpose of obtaining a motion picture film which can be retransmitted at a later date presents many interesting problems. The main difficulties arising are due to the short intervals between television frames, the line structure of the image produced on the film, and the various optical, electrical and photographic processes involved.

These difficulties have been largely overcome in Britain by the use of a continuous motion camera employing optical compensation, by eliminating electrically the line structure on the Kinescope which is being photographed, and by other means which will not be discussed here. This paper deals only with the tone reproduction side of the television recording process.

Tone reproduction in television generally does not appear to have received as much attention as it warrants. Apart from a few excellent papers by American authors^{1, 2} there is very little in the published literature which does more than touch on the subject, and yet the author is personally convinced that

correct tone reproduction (with adequate contrast range) is probably the greatest single factor in determining the subjective quality of any television image. Pictures with low definition, measured in terms of lines, can often be very acceptable providing that the tones in the subject are reproduced with the correct tone separation and contrast range.

With the object of improving the tonal characteristics of B.B.C. television recordings, a series of tests were carried out during 1950 and 1951 to investigate the transfer characteristics of all processes from the television camera to the final print of the finished "Telefilm," as television recordings are called in Britain. Before considering these characteristics in detail, it will be of interest to compare the number of processes involved in the case of Telefilm, or motion picture film made by television, with the processes involved in the production of an ordinary motion picture film.

The following table does not take into account the possibility of dupe negatives, etc., but gives the minimum number of processes in each case.

Film made by Television	Film made by usual methods
a. Television camera transfer characteristic (including optics).	
b. Electrical linearity of television system.	
c. Transfer characteristic of cathode ray tube used for recording.	
d. Optics of recording camera.	Optics of camera.
e. Overall characteristic of neg. stock and its development.	Overall characteristic of neg. stock and its development.
f. Grading of print.	Grading of print.
g. Type of printing stock and its development.	Type of printing stock and its development.

* British Broadcasting Corporation

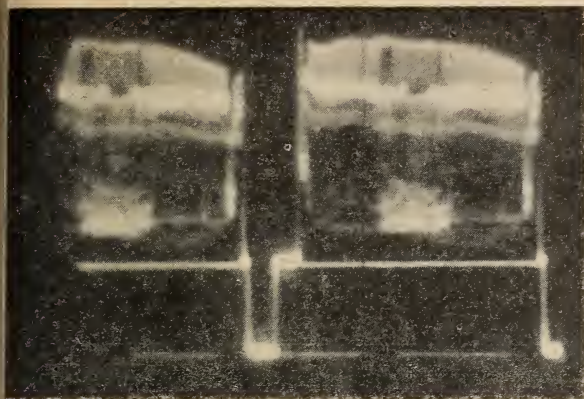


FIG. 1

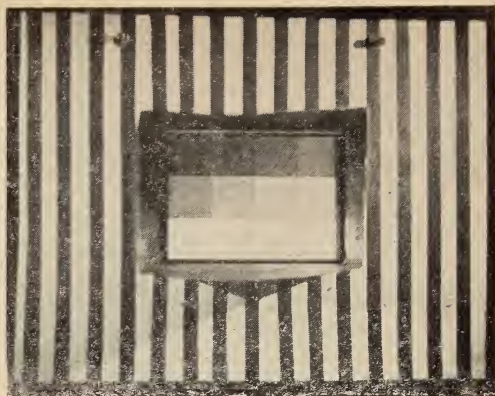


FIG. 2

It will be seen that the first three processes are peculiar to telefilms, but that the second four processes are common to ordinary film technique. It should not be assumed, however, that these processes are necessarily the same in both cases.

When a final positive is retransmitted the following additional processes have to be taken into account:—

- h. Overall transfer characteristic of film transmitting equipment (including optics).
- i. Overall electrical linearity (including transmitter and home receiver).
- j. Transfer characteristic of Kinescope used on home receiver (including the effects of ambient illumination and "spill").

Processes h, i and j will normally be common to ordinary films as well as telefilms, and hence it is desirable to make the final print of a telefilm similar in all respects to a normal film print. This, of course, only applies to high quality film transmitting equipment such as the "flying spot" machines commonly used in Britain.

Processes f and g in the above table may be deleted if a negative picture is used on the Kinescope. A single development will then yield a positive, but, due to the absence of grading, very careful control has to be exercised over the setting up of the Kinescope to ensure a correct positive density. This recording technique is not covered in the present paper since contrast correction is required, and although excellent recordings

FIG. 3

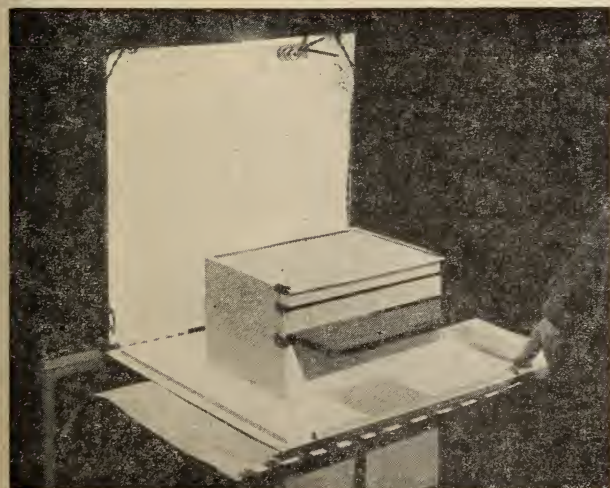
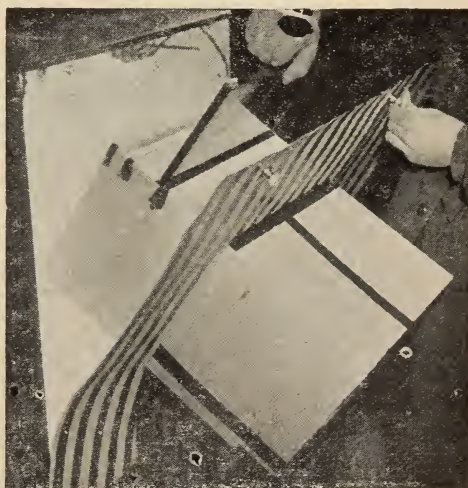


FIG. 4



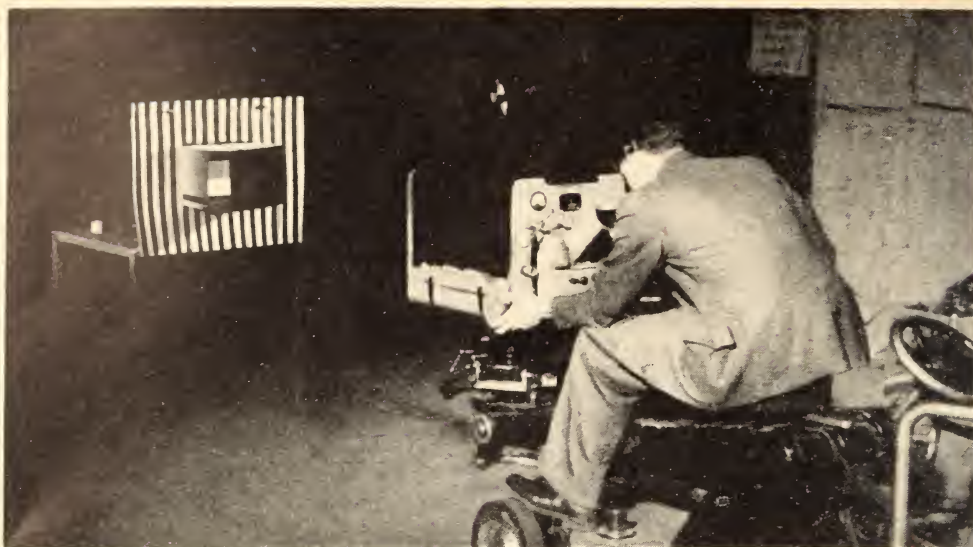


FIG. 5

have been produced by this method it is still to some extent experimental.

The question of recording the sound accompanying the vision programme will not be dealt with here. At the present moment the B.B.C. uses a combined 35 mm. television recording camera using a variable density sound track. This is, of course, not suitable for high gamma development in process e above, and if it is desired to use development

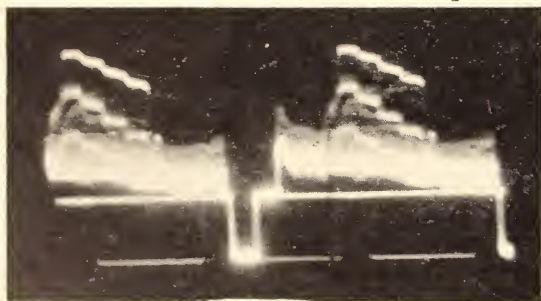


FIG. 6

of this type variable area would be more suitable. However, it is expected that the difficulties associated with the sound track requiring different processing conditions to the vision record will ultimately be solved by the use of magnetic tape recording and subsequent re-recording direct on to the final positive. Such a technique would be particularly applicable to 16 mm. film, with which recording experiments are now in progress.

From the above table it will be seen that to obtain reproduction of a television programme by means of television recording involves about ten transfer characteristics. It will be readily realised that very careful control has to be exercised over each process to ensure consistent results, and with so many processes a large number of different techniques are possible. The B.B.C. technique during 1950 will now be discussed, it being realised that the electrical contrast correction referred to later has now caused considerable modifications and improvements.

For the benefit of those who are not fully conversant with the B.B.C. television waveform some factors of this, relevant to tone reproduction, will now be discussed.

B.B.C. Television Waveform

Fig. 1 shows a photograph of a waveform monitor with the time-base running at line frequency. Due to the exposure time (about 1/25th second) all active line signals are superimposed in this photograph. The lower 30% of the signal is concerned only with synchronisation, the 30% value of the signal (*i.e.* the top of the synchronising signals), being known as black level. It is usual to arrange that the picture signal lies between 33.5% and 100%, in which case the lower limit of the signal is known as "picture black," the upper limit as peak white. The

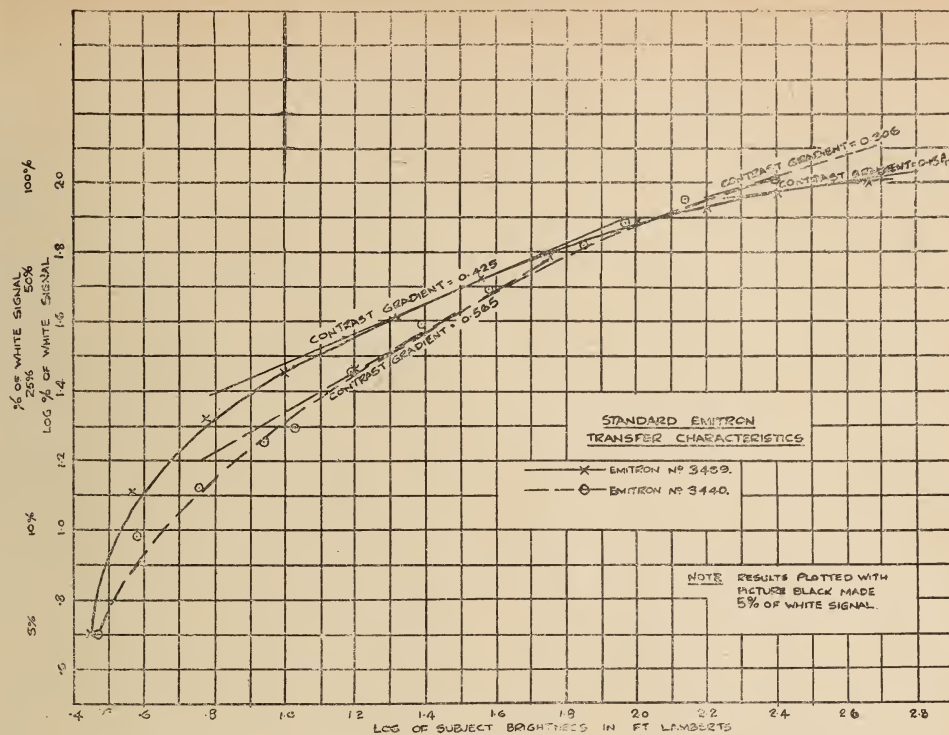


FIG. 7

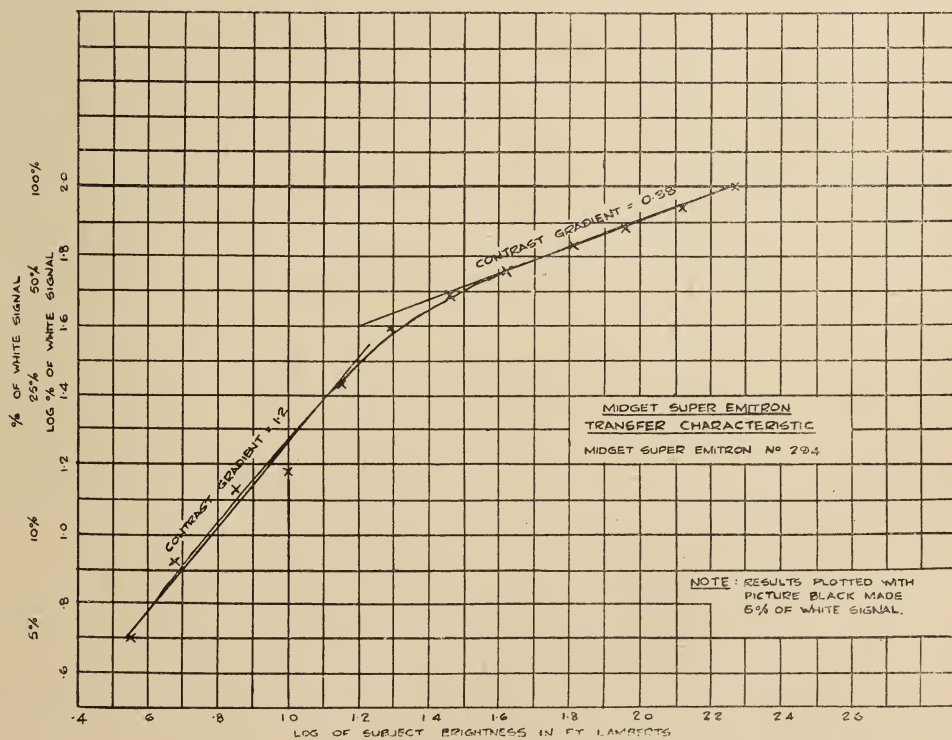


FIG. 8

difference between black level and "picture black" is called in Britain "the lift," which is normally 5% of the picture modulation.

It is interesting to note that if the contrast gradient of the kinescope tube is 2.0 (*i.e.* a square law response) and the grid voltage is adjusted so that the beam is just cut off at black level, then for a contrast range of 100:1 on the Kinescope (*i.e.* beam current change of 100:1 between peak white and the darkest tone or picture black) the voltage range will be $\sqrt{100}$ or 10:1, *i.e.* from 100% to 36.6% in Fig. 1. Of course, many subjects do not possess such a high contrast as this, in which case the signal will lie between the 36.6% and 100% values.

Any particular tone in the picture will be represented by a particular voltage, and this may be expressed as a percentage of the peak white signal.

Overall Television Camera Transfer

Characteristic

There are a number of different cameras at present used by the B.B.C. or under test by the B.B.C., as follows:—

1. The Standard Emitron (Iconscope type).
2. The Midget Super Emitron (Super Iconscope type).
3. The Photicon (Super Iconscope type).
4. The P.E.S. Photicon (Super Iconscope type—experimental).
5. The C.P.S. Emitron (Orthicon type).
6. The Image Orthicon.

The first four cameras employ high velocity scanning, the last two low velocity scanning. With all high velocity pick up tubes is associated a defect known as "shading." This takes the form of a "lift" which varies over the picture area, and is normally compensated for by inserting artificially generated signals of similar shape in antiphase. Unfortunately, the "shading" varies to some extent with picture content, and therefore the shading controls may require adjustment during transmission. The presence of shading means that rather special means must be employed to obtain a camera transfer characteristic.

Method of Measurement

It is required to focus the camera on a test

object containing a number of known tones. It is essential to cover a range of tones similar to or exceeding that of the most contrasty subject likely to be encountered, and therefore a transparency must be used, as the greatest contrast ratio which can be obtained from an opaque density wedge is only about 30:1.

The transparency used for the following measurements consisted of twelve steps covering a contrast range of 150:1, which is more than is usually encountered under studio conditions.

Fig. 2 shows a front view of this transparency showing the arrangement of the steps. It is extremely important to ensure absolutely even illumination, and the method of achieving this is shown in Fig. 3. This shows the transparency holder, which consists of a box with the rear surface sprayed with flat white paint. This surface is illuminated by four pearl 100W. lamps. About one inch behind the transparency is a piece of opal glass which provides supplementary diffusion. No direct light falls on the transparency. It has been found that the illumination of the transparency is remarkably constant over the whole field. It is important that no external light falls on the front of the transparency, and to this end a mask is fitted in the front of the box as seen in Fig. 4.

Fig. 5 shows the transparency box set up in front of a television camera. To minimise the effects of the shading referred to earlier, the transparency is made to cover about one-third of the picture horizontally and vertically (*i.e.* 1/9th of the picture area). The remaining 8/9ths of the picture area is filled with what is known as an "A.C. background"; this has the effect of reducing the shading. The A.C. background may consist of a fine black-and-white pattern whose mean brightness is midway between that of the black-and-white steps of the transparency. It is illuminated from the side. A small test area has another advantage in reducing possible errors due to variation of sensitivity over the mosaic of the television camera.

Fig. 6 shows a photograph of a signal monitor scanning at line frequency as before, displaying the waveform from the camera,

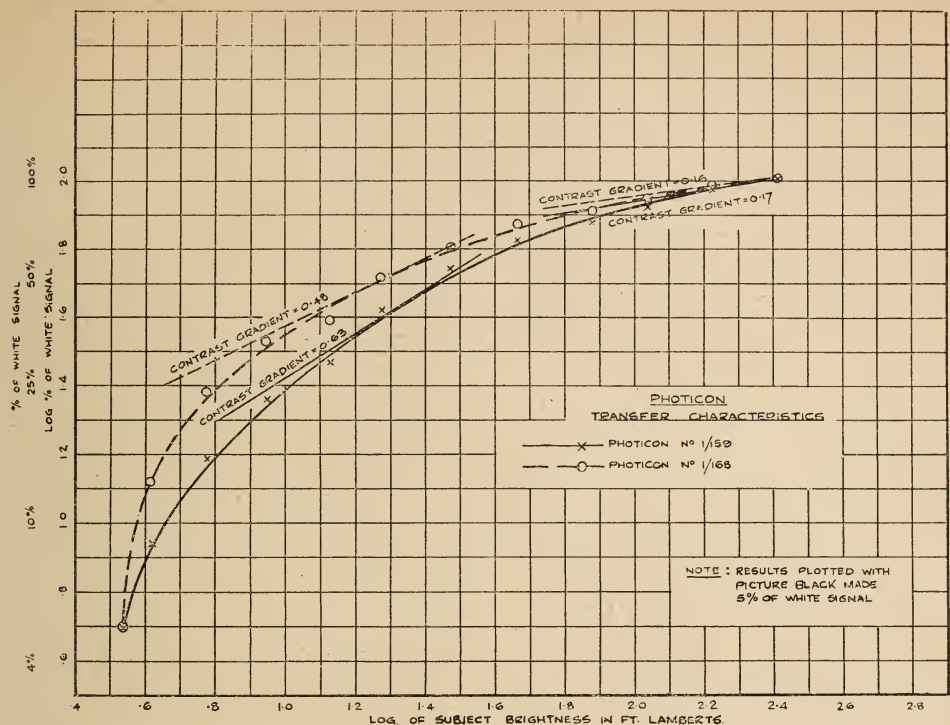


FIG. 9

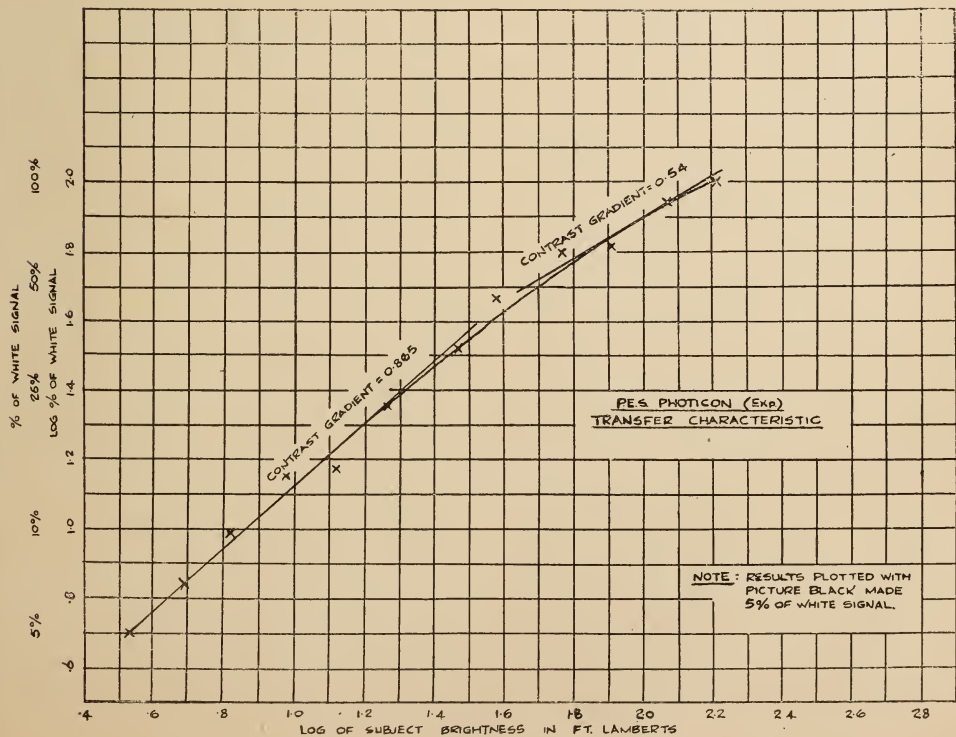


FIG. 10

The shading controls have been adjusted to give flat tops to the steps when scanning at both line and frame frequency. All the steps are visible, due to the $1/25$ th second exposure time used, and these are visible to the eye when looking at the waveform monitor due to the persistence of vision. It is thus an easy matter to adjust the shading. Each camera was set up on a normal studio scene before being panned on to the transparency, and apart from an adjustment of the iris setting, and the shading controls, no other adjustments were made.

The amplitude of each step was measured from black level, the lift being adjusted so that the lowest step occurred at 5% of the picture signal. The experiment is then repeated with the transparency arranged so that the white square occurs in each corner of the picture in turn and the averages of the readings taken. It is found that the effects of shading and mosaic sensitivity variation are then negligible in the averaged results.

The above procedure was repeated with each type of camera, except that in the case of the image orthicon the lens of the camera was capped between readings to avoid the picture being "burnt on" the mosaic.

Transfer Characteristics obtained

Standard Emitron

Fig. 7 shows examples of the Standard Emitron characteristic.

The log of the subject brightness has been plotted as the independent variable, while the log of the percentage of the peak white signal has been taken as the dependant variable. The dependant variable, therefore, ranges between 2.0 (*i.e.* log 100) and 0.7 (*i.e.* log 5).

The slope of the curve has been termed the contrast gradient. It is closely analogous to the photographic term gamma, but it is felt that as gamma relates to the density-log exposure curve in photography, and as the curve we are considering relates log voltage to log brightness in television, a different name is useful to prevent confusion.

The contrast gradient will be seen to vary over the brightness range. At low intensities it is high, for mid-tones it settles down to a

more or less constant value of about 0.5, while in the highlights it falls off to about half this figure.

The Midget Super Emitron

As this camera is only in experimental service with the B.B.C., it was not possible to obtain the characteristics of several pick-up tubes. However, it will be seen in Fig 8 that the characteristic obtained tends towards two contrast gradients, about 1.2 for the darker tones and about 0.4 for the lighter tones. There is little loss of contrast gradient in the extreme highlights. As will be seen later when the overall television characteristics are considered, this is a valuable feature.

The Photicon

The characteristic of these tubes shown in Fig. 9 is similar to that of the Standard Emitron. The loss of contrast gradient in the highlights is perhaps somewhat more marked.

The P.E.S. Photicon

This pick-up tube is again experimental. It is mechanically similar to the Photicon, but the secondary emission effects which cause "fuzz" have been largely eliminated by special electro-optical means. It will be seen that the contrast gradient in Fig. 10 is much more constant over the brightness range, with a rather higher mean value. The loss of contrast gradient in the highlights is very small.

The C.P.S. Emitron

This pick-up tube, which is of the low velocity type, tends to have a linear relationship between brightness and output voltage. Each camera channel is provided, however, with an electrical contrast correction circuit which is intended to change the linear relationship into the required power law.

The full curve and dotted curve in Fig. 11 show characteristics taken with different settings of the original contrast correction amplifier.

The chain dotted curve shows a characteristic taken with the latest type of contrast correction amplifier, set up for optimum conditions. It will be seen that a very considerable improvement has been effected, and that the camera channel is now capable of accepting the higher brightness range accom-

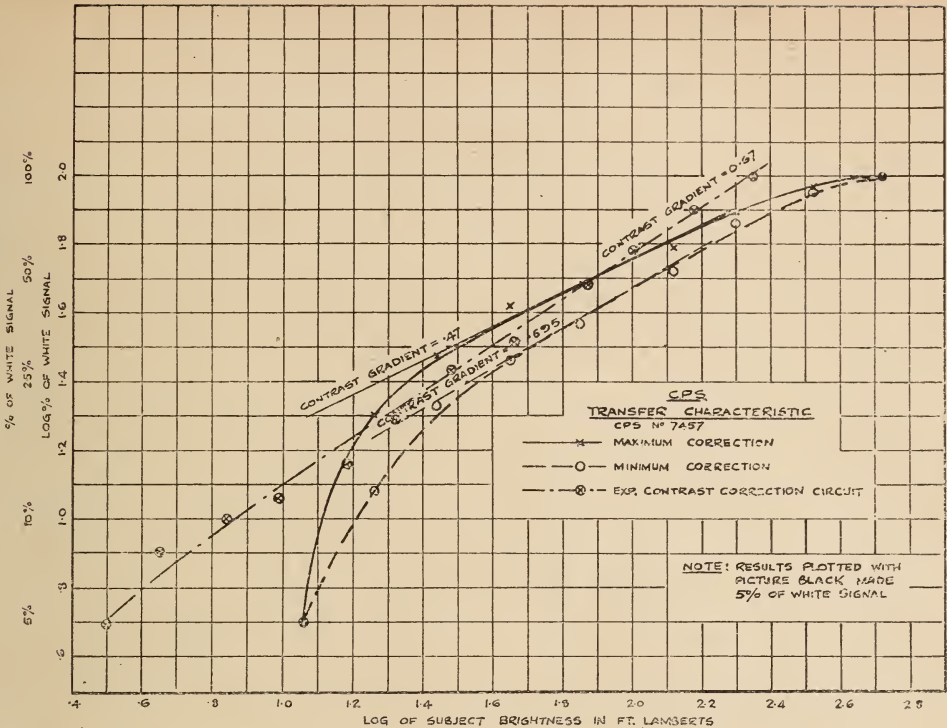


FIG. 11

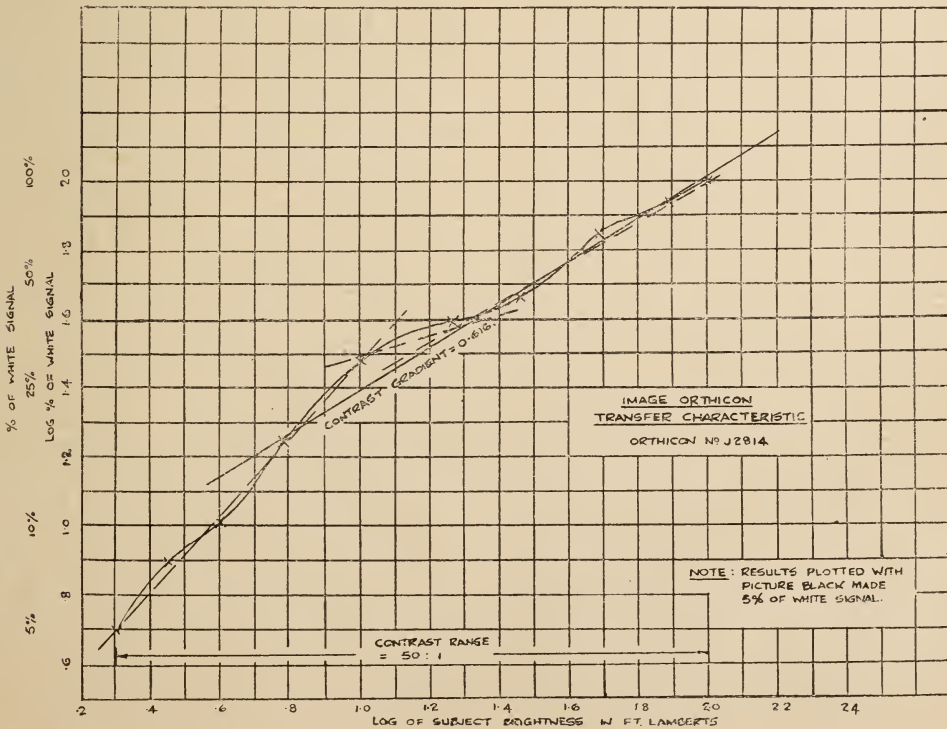


FIG. 12

modated by other types of camera.

There is little loss of contrast gradient in the highlights; the signal noise ratio in the black is, however, somewhat adversely affected by the higher degree of contrast correction required.

The Image Orthicon

It is not easy to obtain a transfer characteristic of the image orthicon because of the tendency for the picture of the transparency to "stick" on to the mosaic, and also because of the electron optical effect known as "redistribution."

The curve shown (Fig. 12) gives a contrast gradient in excess of unity in the darker tones of the picture, with a "knee," or change-over point, in the middle of the characteristic, followed by a contrast gradient of about 0.6 in the lighter tones. There is little loss of contrast gradient in the highlights.

The curves will illustrate the difficulties of obtaining consistent results in recording. Ideally, it is necessary to apply correction to each type of camera individually to obtain a standard transfer characteristic which would be the same for any camera, and no doubt this will be done in time. At present, however, different degrees of contrast correction should be used in recording programmes from each type of television camera.

Electrical Linearity of Television System

B.B.C. specifications for individual items of equipment usually lay down a $\pm 2\%$ tolerance on amplitude linearity up to 100% modulation, and in many cases an additional tolerance of $\pm 5\%$ up to 150% modulation. The overall tolerances on a complete television system would, of course, be somewhat increased, particularly if a very large number of units were involved (as in certain outside broadcasts). Where line or radio links are used it is customary to provide a limiter operating above 100% modulation to ensure that no overload greater than 10% or 20% is passed over the link.

However, unless actual overload is occurring (*i.e.* the slope of the input/output curve changes rapidly), it is considered that the effect on the overall response is small when compared with other factors. Unfortunately,

this effect tends to crush highlights, which are often already compressed in the camera tube. Contrast correction, which is controlled non-linearity, is dealt with at the end of this paper.

Transfer Characteristic of Kinescope used for Recording

The relationship between the applied grid voltage and beam current of any Kinescope tends towards a power law, usually of a power index greater than 2. As the beam

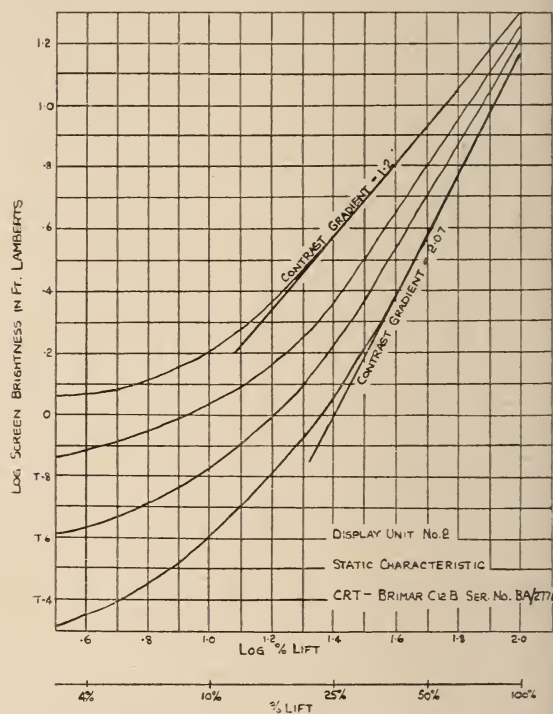


FIG. 13

current is proportional to the screen brightness over most of the required range, the relationship between the input voltage and screen brightness is also a power law.

The transfer characteristic can thus be expressed, as in the case of television camera, by the curve relating the log of the screen brightness with the log of the percentage of peak white signal.

The power law characteristic will be modified by the ambient lighting conditions and

STANDARD EMITRON
OVERALL RECORDING CHARACTERISTIC

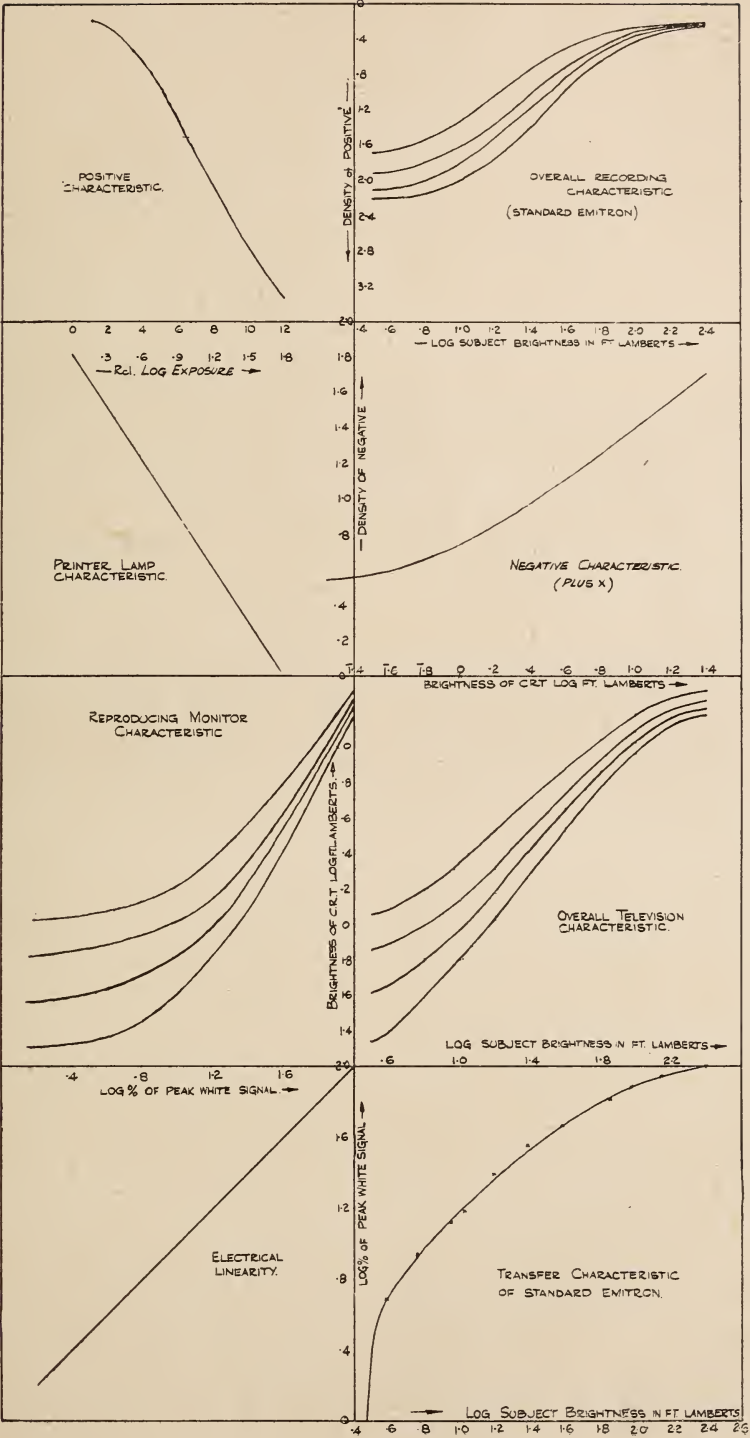


FIG. 14

other factors such as internal reflections in the cathode ray tube. We may therefore consider two characteristics, the static characteristic, representing the response under idealised conditions, and the dynamic characteristic, representing the response under actual working conditions. The dynamic characteristic will depend to some small extent on the picture content.

With television recording Kinescopes, which usually have aluminium backed screens, and are used in conditions of extremely low ambient lighting, there is little difference between the static and dynamic characteristics.

The overall static characteristic of the Kinescope and its modulating amplifier may be obtained by applying a complete picture and synchronising signal in which the picture consists of a D.C. potential, which can be varied from black level to peak white. The presence of synchronising signals enables any black level clamps used to function normally, and as the complete screen is of uniform brightness it is easy to measure this by means of a photo emissive or photo voltaic cell. Alternatively, a visual photometer may be used. The transfer characteristic shown in Fig. 13 was taken using the above procedure, the screen brightness being measured by a telephotometer.

A family of static characteristics of the Kinescope which until recently has been used for recording is shown. The curves were taken with various brightness or grid bias settings. Due to the difficulty of obtaining adequate exposures on the film it was necessary to record with a grid bias such that the beam current was not zero at black level. This is the reason for the loss of contrast gradient in the lower parts of the picture. Over the voltage range from 10% to 100% of the picture signal, however, it will be seen that the departure from the true power law is not very serious. It is, however, enough to increase the black compression in the overall recording characteristic. This Kinescope has a white phosphor and is 12 ins. in diameter.

Recently blue phosphors have been introduced, with higher screen brightness. These give adequate exposure to render the above

bias conditions unnecessary, and the departure from a true power law is negligible between 10% and 100% of the picture signal.

Fig. 13 shows a contrast gradient over the higher tones of the picture of about 2.0. At lower values of grid bias this falls off to about 1.2. The normal operating conditions for recording would be between the limits of the lower two curves. The rather low contrast gradient of this Kinescope is useful because it allows a higher photographic gamma on the negative which improves sensitivity while keeping the overall gamma only slightly over unity.

Optics of the Television Recording Camera

There is no very considerable difference here from normal motion picture camera practice, except that the continuous motion television recording camera has a rather complex optical system which tends to reduce the contrast due to reflections at the various air-glass surfaces. These have been coated, and every precaution has been taken to minimise reflections from other causes.

The effect of the television recording camera optics has been allowed for in the overall characteristics of the negative stock.

Overall Characteristic of the Negative Stock and its Development

At the present moment a fast panchromatic stock is employed (Eastman-Kodak Plus X). This has considerable latitude and can easily accommodate wide variations in the incoming signal as well as variations in the setting up of the recording Kinescope.

As the variable density sound track is recorded on the same film the negative control gamma is limited to about 0.65.

Experimental recordings have been made with blue Kinescopes using Eastman-Kodak 1398 variable area sound recording stock, developed as a negative to much higher control gamma. In this case contrast correction must be applied to reduce the overall gamma of the television picture. Excellent results have been obtained, but the method cannot be put into operational use until variable area sound recording or magnetic recording is introduced.

It is important to obtain the negative characteristic by using a television picture for

CONTRAST CORRECTION REQUIRED FOR
CORRECT TONE RENDERING

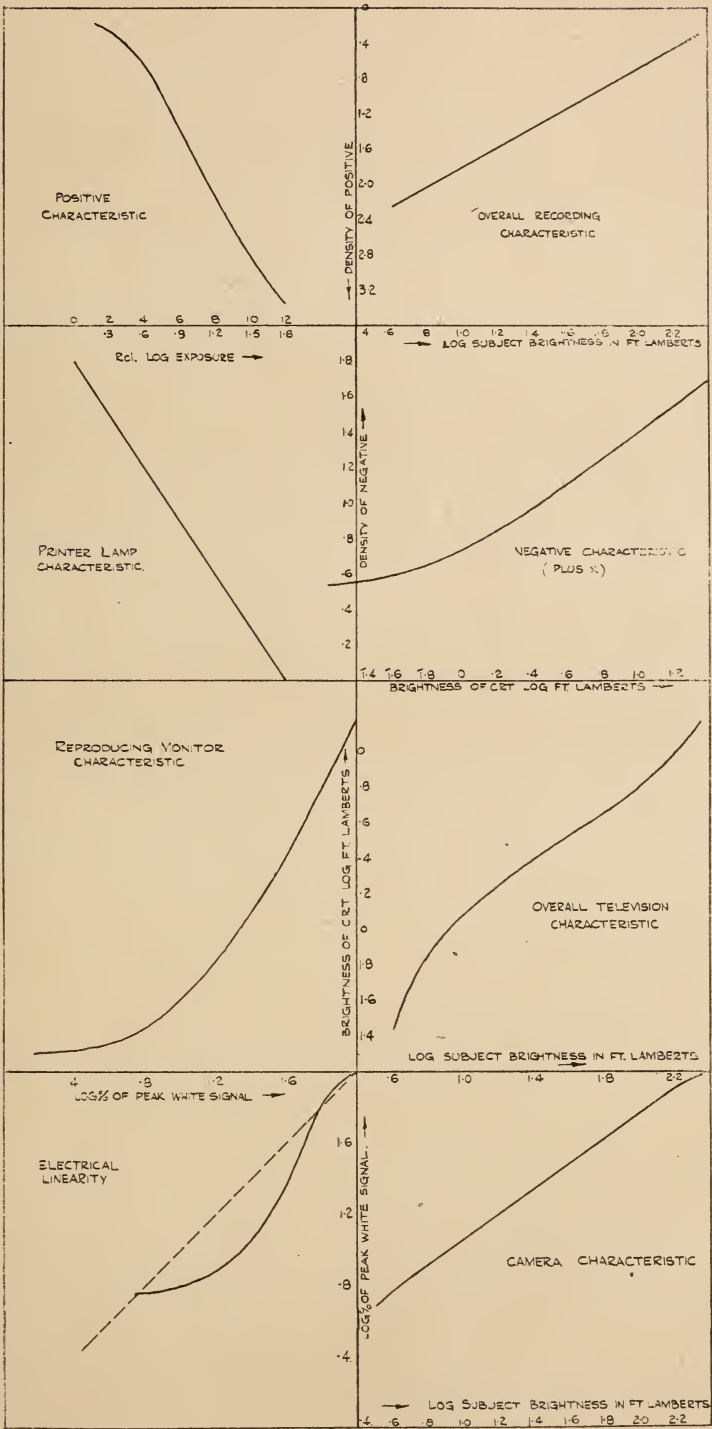


FIG. 15

two reasons. First, the spectrum of the light from the television screen may differ considerably from that of the sensitometer used by processing laboratories, and secondly, the law of reciprocity breaks down due to the extremely short exposure period. The total exposure time of any one element of film corresponds to the time of scanning one picture element of the television image, plus a longer period of afterglow during which the brightness decays exponentially. Even with long afterglow Kinescopes this is short by photographic standards.

The negative characteristic shown in Fig. 14 was taken by exposing film in the television recording camera; the television picture of each step was measured on the Kinescope face by the same telephotometer as was used to obtain the Kinescope transfer characteristic, and thus the spectral characteristic of this is not important. The sensitometer control gamma was 0.65.

Grading of Print

This follows normal motion picture technique; less frequent shot to shot grading is required since this is controlled by the camera operators.

Overall Characteristic of the Printing Stock and its Development

Normal motion picture technique is again used, the print being developed for density rather than to an exact control gamma, which therefore varies between 2.2 and 2.4.

It is important to keep to standard printing technique as this simplifies the speed and ease of obtaining copies.

Overall Television Recording Characteristic—Standard Emitron

It is now necessary to combine the various transfer characteristics which have been discussed to obtain the overall result.

Fig. 14 shows a graphical method which is valuable because it enables the particular effect of each characteristic to be seen at a glance.

The lower four squares contain the television transfer characteristics. On the bottom right has been plotted the transfer characteristic of the standard Emitron. For any particular brightness in the original scene the corresponding percentage peak white signal

can be obtained. If this is projected horizontally to cut the electrical linearity characteristic (assumed linear) and then vertically to cut the particular Kinescope characteristic in use, the brightness on the face of the Kinescope for this particular subject brightness can be read off on the vertical scale. The point where this brightness cuts the vertical line drawn from the corresponding brightness of the subject is one point on the overall television characteristic, which can thus be drawn in the top right of the bottom four squares.

It will be seen that the standard Emitron in combination with the cathode ray tube used for recording gives a mean overall contrast gradient of slightly greater than unity at low brightness settings, and slightly less than unity for the higher brightness settings. There is compression of the higher tones of the picture in all cases. The darker tones of the picture are compressed only at high brightness settings.

To obtain the overall recording characteristic it is necessary to transfer the brightness obtained on the Kinescope to the negative characteristic. This has been done by a transfer line in the overall television characteristic square of slope unity, which has not been shown. The top four squares show the well-known photographic tone reproduction diagram, which leads to the overall recording characteristic shown in the top right hand square. Four overall characteristics have been plotted corresponding with the various brightness settings of the Kinescope.

It will be seen that all four characteristics show compression in both the higher and lower tones of the picture. The compression in highlights appears to be due mainly to the television camera characteristic and the positive characteristic, while the compression of the darker tones is due mainly to the toe of the negative characteristic combined with the loss of contrast gradient in the darker tones of the Kinescope at high brightness setting. The brightness setting of the Kinescope which produces least compression of darker tones in the overall television characteristic, produces most compression in the overall recording characteristic due to work-

OVERALL RECORDING CHARACTERISTICS

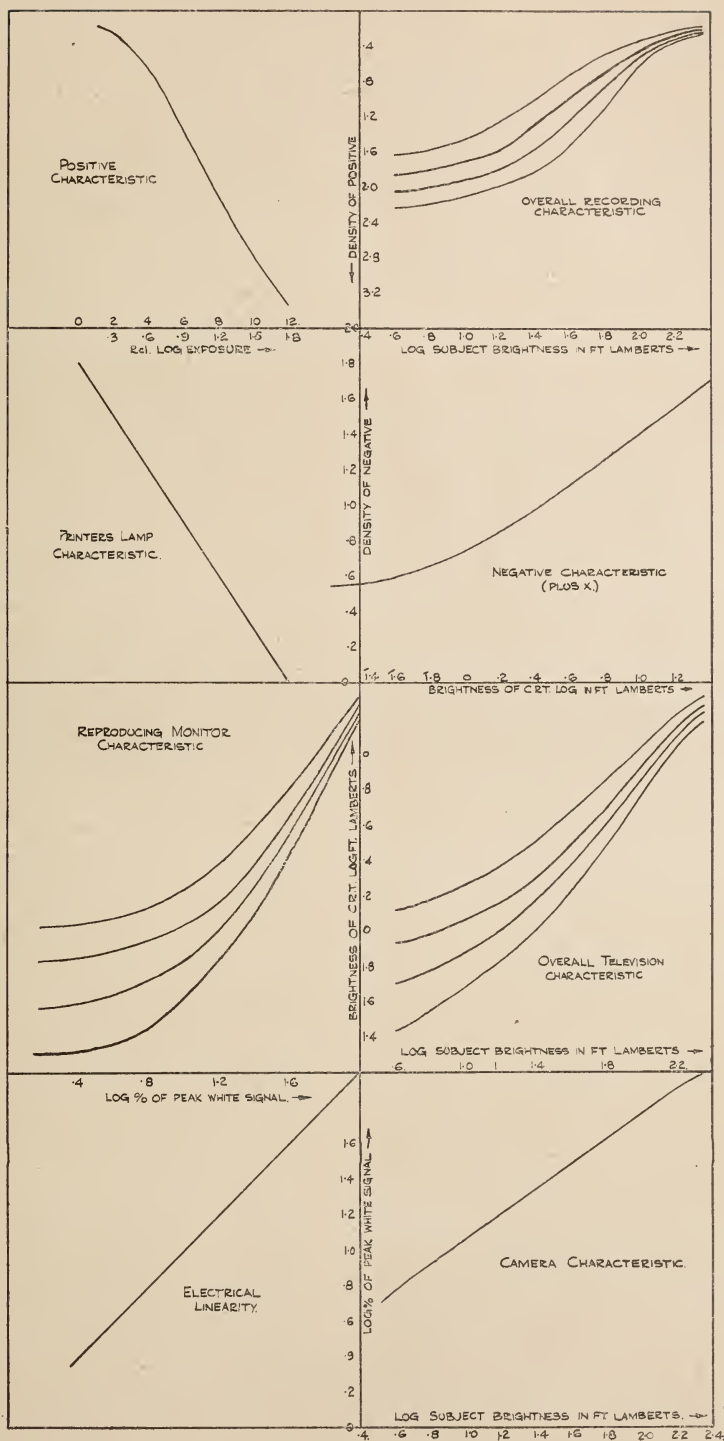


FIG. 16

ing too far round the toe of the negative characteristic.

The Overall Recording Characteristic with an Ideal Camera

In Fig. 15 the overall tone reproduction diagram has been plotted from a camera with a very nearly constant contrast gradient. The C.P.S. Emitron when fully contrast corrected approximates to this characteristic.

It will be seen that the overall recording characteristic is still compressing both dark and light tones due to the positive and negative characteristics of the film process.

Contrast Correction

Of all the transfer characteristics which have been discussed, possibly the most flexible is the electrical linearity, as this can be easily changed by the use of non-linear elements such as crystals, valves, etc.

Fig. 16 shows the electrical linearity curve which would be required to produce a constant gamma on the final positive from the characteristics shown in Fig. 14. The density range being kept the same as in Fig. 14, the overall gamma is less than unity.

The electrical linearity required is a considerable expansion of the darker and lighter tones in the picture, but it should be noticed that the mean slope of the electrical linearity curve has stayed constant at unity. There is no electrical change of overall contrast gradient in this case, which represents true contrast correction.

It is possible to change the slope, or contrast gradient of the electrical linearity, by using circuits with a power law response. This necessitates corresponding changes in the slope of one of the other transfer characteristics to keep the contrast gradient of the overall television recording characteristic correct. By using a lower electrical contrast gradient (*i.e.* a power law of index less than unity) the electrical signal corresponding to a dark tone in the subject is made a greater percentage of the white signal. This corresponds to an increase in effective brightness

of the recording Kinescope, and makes possible the use of high resolution film stocks of lower sensitivity. When using this technique the contrast range on the Kinescope is reduced, but the overall contrast range is restored due to the higher negative gamma.

Experiments are now proceeding with various contrast correction techniques. Preliminary results are encouraging and indicate that from the tonal response point of view there is no reason why telefilms should not ultimately be comparable with normal motion pictures. Indeed, there is the interesting theoretical possibility of producing an overall television recording characteristic which would provide a linear density/log subject brightness law, which would be at present unattainable by photographic processes alone.

Acknowledgments

The author wishes to acknowledge the valuable assistance of Mr. W. H. Cheevers and Mr. B. R. Greenhead, of the B.B.C. Planning and Installation Department, and of members of the B.B.C. operational staff in carrying out the experimental work involved, and also to thank the Chief Engineer for permission to publish this paper.

A short television recording was shown which was taken from a standard Emitron transmission, under conditions approximating to the second and third Fig 13 curves. This transmission was one of the "Made by Hand" series and was entitled "Marbling." A television recording was then projected taken from a Photicon camera. This was from the Children's Hour programme and was entitled "Landmarks of London—Trafalgar Square." This was followed by a television recording from a C.P.S. Emitron camera. This was from the programme series "In the News."

The final television recording was from an Image Orthicon Outside Broadcast camera. This extract was taken from the recording of the visit to the Royal Opera House, Covent Garden, London, by the French President, and Mme. Vincent Auriol.

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1. *RCA Review*, 11, Sept., 1950; *RCA Review*, 9, Sept., 1948.
2. *Brit. Kine.*, 17, No. 5, Nov., 1950, p. 141.

THE SCREEN AT THE FESTIVAL OF BRITAIN TELEKINEMA

J. L. Stableford (Member)*

THE production of the screen for the Telekinema was a most interesting project. It is seldom that one can find the making of a screen which bristled with so many conflicting requirements. For, at the Telekinema, a combination of things never essayed before was being attempted. A summary gives:—

- (1) Ordinary projection with special reference to true spectral response in colourwork.¹
- (2) Large screen television.²
- (3) Stereoscopy by polarised light.³
- (4) A blended colour surround.
- (5) Stereophony.⁴

The first two are already well known in this country.

The other three have never been attempted on any scale to the general public, at least not in combination. Possibly, the most novel item will be considered to be stereoscopy. There is no new inventive matter in the way it is presented in the Telekinema.³ What is interesting is that stereoscopy makes its début before the paying public by a method which could be adopted by kinemas throughout the world without too great an upheaval, financial or otherwise.

Briefly, the existing cameras (two locked together) can be used, also the existing projectors (two synchronised). The full 35 mm. format of the film is used, so that a print from either a right eye or left eye negative could be sold to any kinema in the world and projected monoscopically for the sake of the very necessary revenue. An essential link in this chain was that a screen thoroughly suitable for normal use should also be usable for polarised stereoscopic projection.

Screen for Ordinary Projection

As to the practical aspects of such a screen, its requirements for ordinary projection are fairly well known—it must be efficient, give

adequate picture quality from any seat in the theatre and, for this, a matt white screen is almost universally used. Since a matt white screen depolarises light, this had to be ruled out and a metallic semi-specular type of screen considered. It is well known that this type of screen is highly directional, with a high nodal point of reflection at an equal and opposite angle to the incident ray, with extremely rapid fall-off to the sides.

The metallic or silver screen was used by the film industry in its infancy, in view of the inadequate amount of light available from the then existing arc lamps, and could be tolerated because theatres generally were long, narrow, converted halls. The name "silver screen" still persists but only as an adjective for the industry.

Drastic alteration had to be achieved in the polar curve of the existing metallic screen so that adequate coverage over a wide arc could be given.

At first, one would suppose that merely roughening the surface and then coating it with silver lacquer would give the degree of scattering required, but this is not so. The scatter is then so uncontrolled, being very high at large angles from the normal to the screen, the effect is unpleasant and the reflectance low, under certain conditions, even lower than a matt white.

A Lenticular Surface

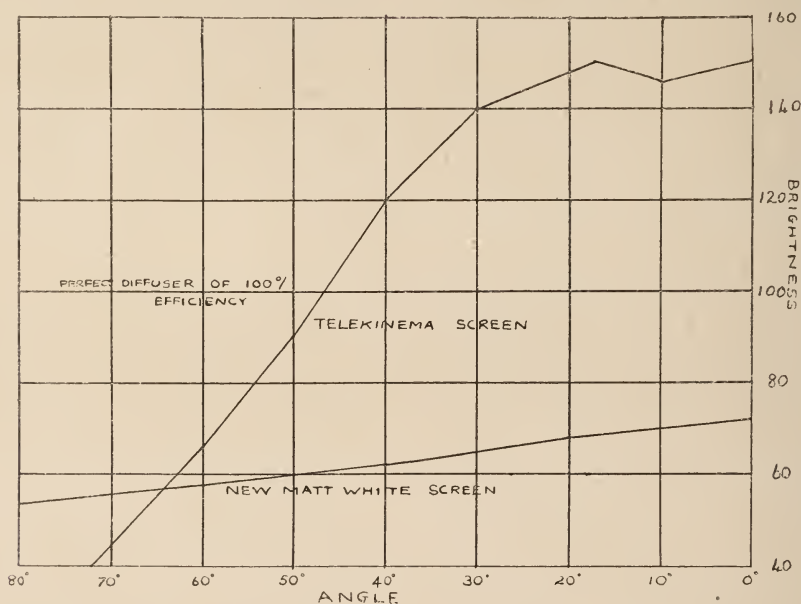
Much experiment has shown that one way of achieving the desired result is to produce a truly lenticular surface with the object of placing the reflected picture exactly where the audience are seated and not beyond this. Practical large scale experiments were started before the war, were resumed and have been going on ever since the termination. They have provided a lot of data and factual know-how as to what probable results could be obtained. It seemed certain that fairly high

* Stableford Screens, Ltd.

reflection factors could be achieved which would give picture illumination beyond all comparison with present-day practice.

Compared with a virgin matt white screen, a factor of about 3:1 over a fairly wide arc has been consistently obtained, with a flat topped polar curve over 35° to 40° of arc. This factor drops to about 2:1 at about 70° of arc and drops to 1:1 at about 100° of arc. After 100° , the picture rapidly falls off and becomes so low as to have no entertainment value. This is the required condition, as no patron is seated outside the 100° arc in any theatre. Even the widest modern

low brightness of the picture. By reason of the fundamental principle of this system of stereoscopy, the reflected value of the picture received by the retina of the viewer's eye is rather less than 30% of the incident value. To appreciate the significance of this, if a 70% stop filter is placed in front of the existing normal projection equipment, the dissatisfaction produced would soon empty any theatre. This 70% loss of light had to be made up. By the decision to use two full 35 mm. frames on separate films, illuminated with two arc lamps, a gain of 100% was made immediately. This therefore takes us



kinema seldom calls for more than 90° of arc. To realise what these factors mean, it should be appreciated that it would require two or even three arc lamps projected through the one film to produce approximately the same result. Since the modern arc is already dangerously near overheating the film, obviously the latter is not practicable.

Low Brightness of Picture

Reverting to the problem of stereoscopy, there is no secret at all in producing a three-dimensional effect by means of polarised light. What is so inadequate about doing it is the miserable and depressing effect of the

up to something under 60% of the accepted normal incident light.

If a screen with a goodness factor of between 2 and 3 over a matt white screen is used, this represents (on the minimum figure of 2) a further gain of 100%. Twice 60% takes us up to well over 100%. In this way, the general level of illumination perceived by the viewer has been brought up to the standard of a modern kinema theatre showing ordinary films.⁵ But to do so has necessitated finding over 400% increase in light.

Difficulties Experienced

One snag was met during the experimental period whilst working with the equipment

being produced by the B.T.H. Co.⁶ under similar working factors as the Telekinema. The throw is on the short side, just over 50 ft., and the spacing between the two projectors was the usual five feet. There was thus a substantial angle subtended between the two projectors and the screen. Since the two projectors were producing respectively a right and left eye image this difference in angle could produce a noticeable difference in light value between the right and left eye images as viewed from the extreme sides of the Telekinema, if a very high efficiency screen with an adequate but, nevertheless, pronounced directional effect was used. As a result of this, the reflection of the screen was kept down to a factor of 2 and this lower factor enabled the distribution of the polar curve to be maintained, with very little fall-off over the whole of the viewing arc.

Again, this brought us into dangerous country, as, to over-simplify, polarised light is depolarised as a function of the degree of diffusion in the reflector. A matt white surface being a nearly perfect diffuser depolarises completely. The specular metallic mirror does not depolarise at all. If there was any substantial degree of depolarisation introduced into the screen, it would intrude the left eye image into the right and vice versa. It was a nice point to produce the right degree of levelling the polar curve without introducing any noticeable depolarising effect.

Large Screen Television

Dealing with some of the other requirements for the screen, large screen television was the next requirement to be considered.

In the earlier experimental work which has gone on with this type of screen, the aim has been to produce a screen with the highest possible reflecting factor, consistent with adequate coverage. As stated, factors up to three have been obtained consistently. Such a screen can give a remarkable picture in a normal theatre and it was with such a screen that Cinema-Television, Ltd., have given their 20 ft. wide picture demonstrations during the past year or two.² Incidentally, that screen is also acting as the normal screen at

the theatre for everyday projection of films. To be fair to Cinema-Television, Ltd., it must be stated that the picture they are producing at the Telekinema is not as good as could be produced in an ordinary theatre with ordinary viewing requirements, as the peculiar requirements of the Telekinema from stereoscopy, shortness of throw, have acted against using the most efficient screen. However, very few kinema theatres have a throw as short as 50 ft., so that, even if they were showing stereoscopy in the future, a higher factor of screen reflectance could be used.

Colour Pictures

With regard to the projection of normal pictures in colour, it is known that the normal matt white screen is strongly reflective at the red end of the spectrum and somewhat lacking at the blue end. When the screen discolours with age, staining by tobacco tar, the shift to the red becomes much more pronounced and the response in the blue is largely filtered out. This chromatic distortion is carried right through the visual octave.

Of all the better known reflective surfaces, there is one which is distinctly better than most others from a chromatic point of view, and that is aluminium. Its reflectance goes very far into the ultra-violet field, whereas silver, the normal by which reflecting standards are judged, tails off badly by the early violet. Since aluminium is so freely available it is the obvious choice of surface and with its inherent resistance to staining and long stabilised surface life, it would enable the colour film producers, for the first time, to work to exact data of colour.

Blended Colour Surround

The blended colour surround went through many phases of development, and from practical experiments early on it was soon discovered that any surface which diverted from the plane of the screen by however slight an amount produced from different parts of the surround very tricky conditions of light and shade. It was the obvious thing to put the surround in the plane of the screen by a continuation of the latter beyond the picture line. It is conceivable that the surround could be curved gradually into the

auditorium, but this curvature away from the plane of the screen could only start when the light value at the periphery of the surround had reached very low levels indeed. The rather elaborate structures which had been fabricated experimentally were abandoned with acclaim by all concerned. The width of the surround was finally settled in the ratio ; bottom 24, sides 20 and top 15. With all the edges of equal width, the surround had an unbalanced and awkward appearance.

Stereophony

Dealing with stereophony, this is a province not strictly within the scope of the screen, except that the screen could noticeably upset the fine edge of quality and specialised sound distribution called for. With three complete sets of speakers arranged across the screen, each fed by different channels, there is bound to be some diffusion of sound caused by the rear face of the screen. All screens are normally fitted with an acoustic backing cloth to kill the reflection off the back of the screen

coming through the screen again and off the back wall but slightly out of phase. This accepted treatment was given, but it was found necessary to produce as near as possible a honeycomb separation of the three speaker assemblies by acoustic material carried as close to the screen as one dare. After doing this, one is sufficiently near to killing the diffusion effect of the screen as not to mar the startling effect of the stereophony.

If not very much has been given about the actual manufacture of the screen and the method of producing the required lenticular surface, it must be said it is because its manufacture is extremely burdensome and tricky, with a high percentage of failures possible from one cause or another.

The screen for the Telekinéma was produced under laboratory conditions and conditions for full-scale production of such a screen are still under investigation. It is hoped that further more concrete news on these lines will be available before very long.

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1. *Brit. Kine.*, 10, No. 1, Jan., 1947, p. 37.
2. *Brit. Kine.*, 15, No. 6, Dec., 1949, p. 178.
3. *Brit. Kine.*, 18, No. 6, June, 1951, p. 172.
4. *Brit. Kine.*, 19, No. 1, July, 1951, p. 19.
5. *Brit. Kine.*, 17, No. 4, Oct., 1950, p. 118.
6. *Brit. Kine.*, 18, No. 5, May, 1951, p. 142.

CANADIAN STANDARDS

A number of kinematograph standards have been published in Canada, as follows:

Z.7.1.6.3. to Z.7.1.6.13—1950: Test Films for 16 mm. and 35 mm. Motion Pictures.

Z.7.1.6.14 and Z.7.1.6.15—1950: Sound Records and Scanning Area of Double Width Push-pull Sound Tracks (normal and offset centreline types).

Z.7.1.7.7.—1950: Projection Room and Lenses for Motion Picture Theatres.

Z.7.1.7.8.—1950: Dimensions for Theatre Projection Screens.

PERSONAL NEWS OF MEMBERS

D. W. ALDOUS is responsible for the high-quality "non-Sync" installation, capable of reproducing normal and all types of British and American microgroove longplaying records, at the new 16 mm. Romany Cinema, Totnes, South Devon.

R. I. T. FAULKNER has become Sales Manager of Rees Mace, Ltd., who are responsible for the Marine Telecommunications equipment of Pye, Ltd.

COURSES OF INSTRUCTION

The Education Committee is arranging two courses to take place during the 1951/52 session.

The first, a course on Camera Technique, will commence in mid-October and will cover such subjects as film stocks and the avoidance of negative damage, types of camera, camera maintenance, photographic lenses, colour cameras and floor technique.

The second, a course on Sensitometry, will commence in the New Year.

Although enrolment forms will not be available for some time, the Secretary will appreciate it if those wishing to attend either course will inform her as soon as possible.

DR. H. T. KALMUS, Hon. Fellow

It is regretted that in the July issue Dr. Kalmus was stated to be a native of New Zealand. He was, in fact, born in New England.

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THE COUNCIL

Summary of meeting held on Wednesday, July 11, 1951, at 117 Piccadilly, W.1

Present : Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), H. S. Hind (*Deputy Vice-President*), R. J. T. Brown (*Hon. Secretary*), D. Cantlay, F. G. Gunn, F. S. Hawkins and R. E. Pulman.

In Attendance : Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. T. W. Howard, S. A. Stevens and A. W. Watkins.

Finance.—Mr. Norman Leever has accepted the office of Hon. Treasurer of the Society until the 1952 election.

COMMITTEE REPORTS

Membership Committee.—The following are elected:—

Auberon Cyril Ward (Member), Uganda Government, British E. Africa.

John Poyner (Student), Data Film Unit, Soho Square, W.1.

Karel Bedrich Kral (Member), Griffin Film Enterprises, Ltd., Betsham, near Gravesend.

Wyndham Lewis (*Associate*), Regal Cinema, Warminster.

James Richard Cranham (*Associate*), Denham Laboratories, Ltd., Uxbridge.

Greville M. Kent (*Associate*), Petersham House, S.W.7.

John K. Hilliard (Member), Altec Lansing Corporation, California, U.S.A.

Jack Kershaw (*Associate*), Motion Picture Technical Service, Kodak, Ltd., Bombay.

Ernest Clifford Norman Buckland (*Associate*), Specto, Ltd., Windsor, Berks.

Stanley Bruce Pitt (*Associate*), Experimental Officer (Photographic), Adelaide.

William McDonald (Member), Pathé Equipment, Ltd., Manchester.

William James Foy (Member), Essoldo Associated Cinemas.

Henry Court (*Associate*), Odeon Theatre, Hendon.

Leslie Peter Clarence Jack Dudley (Member), Stereoptics, Ltd.

The following transfer from Associateship to Membership is approved:—

Albert James Betts, Telekinema, South Bank.

The resignations of four Members and one Associate and the death of one Associate are noted with regret.

Mr. I. D. Wratten is appointed Deputy Chairman of the Committee.—*Report received and adopted.*

Theatre Division.—The *ad hoc* Committee appointed to determine the qualifications of projectionists in relation to the Joint Scheme for the Apprenticeship and Certification of Projectionists is at present engaged in planning a syllabus of training.

Major Bell is appointed Deputy Chairman of the Division and he will also represent the division on the Papers Committee.

Mr. R. E. Pulman is appointed the representative on the Membership Committee, Mr. L. A. Blay on the Journal Committee and Mr. H. C. Stringer on the Branches Committee.—*Report received and adopted.*

16 mm. Film Division. The work being carried out by the technical sub-committees concerned with the 16 mm. Film Investigation has been somewhat delayed due to illness. The programme of papers for the 1951/52 Session is undergoing modification, as originally this was to have been based on the investigation reports, and these will not now be completed until later in 1952.

Mr. Buckstone is appointed Deputy Chairman of the Division, and Mr. Cantlay will continue to be Hon. Secretary.

Mr. M. V. Hoare is appointed to represent the Division on the Papers Committee, Dr. D. Ward on the Membership Committee and Mr. G. H. Sewell on the Branches Committee. Mr. E. Linnell will continue as Library Committee representative.—*Report received and adopted.*

Film Production Division.—Pressure of work makes impossible Mr. F. G. Gunn's acceptance of the invitation to become Chairman of the Divisional Committee, and Mr. B. Honri has agreed to continue as Chairman.—*Report received and adopted.*

Journal Committee.—The publication of the Journal is now up to date. The submission of original and integrated papers for publication in the Journal is considered important and is to be urged.

Further increases in printing costs will probably be reflected in the subscription rates of *British Kinematography* in the New Year.—*Report received and adopted.*

Papers Committee.—The 1951/52 Lecture programme is under review and will be published in the September issue of the Journal.—*Report received and adopted.*

New Patron Members.—Messrs. Cinefonos, Ltd., Bombay, are enrolled Patron Members of the Society.

The proceedings then terminated.

PERSONAL ANNOUNCEMENT

Wanted, Photographic Lens Designer experienced in high quality photographic objective development and design. Permanent position. Attractive salary. Moving expense will be paid. Farrand Optical Co., Inc., 4401, Bronx Blvd., New York, 70, N.Y., U.S.A.

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BRITISH KINEMATOGRAPHY

VOLUME 19, No. 3

SEPTEMBER, 1951

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THE EDUCATIONAL PROGRAMME

LAST year the British Kinematograph Society started a fresh activity by arranging two courses of lectures, one on "Lighting for Kinematography" the other on "Sensitometry." Both proved to be so successful that they were each over-subscribed. The "Lighting for Kinematography" course was repeated during the session, but it was not found possible last year to repeat the "Sensitometry" course. As a result of the success of these ventures, it has been decided to arrange similar courses for the coming session. The "Sensitometry" course is to be repeated, so that those who were unable to take part last year will now have an opportunity.

In place of the course on lighting, another course has been arranged on "Camera Techniques." This will be on the same lines as the lighting course, in that it will consist of a number of lectures, each given by eminent specialists on their own branch of the subject. By this means, it is intended to make the course useful to the junior members of the industry and yet include material that will be of interest to those whose knowledge is more advanced.

General arrangements for the lectures will be similar to those for last year as the organisations that gave valuable help by the provision of such things as lecture theatres, etc., have again kindly agreed to make similar arrangements. The thanks of the Society are due to them for their help.

These courses have been arranged primarily for studio personnel, who can nearly all attend lectures given in the London area. Kinema projectionists work in all parts of the country and can only attend courses given locally. It is, however, desirable that such courses should work to the same syllabus, wherever they are given, and to achieve this the British Kinematograph Society are drawing up at the request of the C.E.A. and the N.A.T.K.E. a syllabus which will cover comprehensively the subject matter required for the training of projectionists.

F. S. HAWKINS,

Chairman, Education Committee.

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LECTURE PROGRAMME—AUTUMN 1951

Meetings to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1, commencing at 7.15 p.m., Sunday 11 a.m. Meetings of the 16 mm. Film Division are held in the G.B. Small Theatre. The visit to the Associated British Pathé Laboratories will take place in the mornings from 10 a.m., admission will be by ticket only.

SOCIETY MEETINGS

October 3 **"Chemical Shortages and the Efficient Use of Processing Solutions."** A Symposium composed of the following papers:

"A Survey of Chemical Resources," by D. H. O. JOHN, B.Sc., A.R.I.C.

"Continuous Film Processing," by F. P. GLOYNS, M.Sc., F.R.P.S.

"Regeneration of Silver Bleach Baths," by F. E. FLANNERY, A.R.I.C.

"Silver Recovery and Hypo Regeneration," by C. J. SHARP, F.R.I.C.

"A New Commercial Photographic Developer" by Dr. J. D. KENDALL, F.R.I.C., D.I.C.

(Joint Meeting with the Royal Photographic Society.)

November 7 **"Colour Cinematography and the Human Eye,"** by R. W. G. HUNT, D.I.C., A.R.C.S., B.Sc.

December 5 **"The Measurement of Film Stress,"** by LESLIE KNOPP, Ph.D., M.Sc., M.I.N.A. (Fellow).

16mm. FILM DIVISION

October 10 **"Industrial Film Technique,"** by D. A. GLADWELL and G. de G. BARKAS.

November 14 **"A Photographic Technique for Producing High Quality 16 mm. Prints,"** by A. TUTCHINGS.

THEATRE DIVISION

Oct. 22 — 23 **Visit to Associated British Pathé Laboratories.**

December 9 **"The New Philips Projector and Sound Equipment,"** a demonstration introduced by FRANK E. DURBAN (Member).

FILM PRODUCTION DIVISION

October 17 **"Painted Matte Shots,"** by E. HAGUE and P. ELLENSHAW.

November 21 **"Technical Aspects of 'The Tales of Hoffman',"** by C. CHALLIS.

THE RATIONAL APPLICATION OF SPECIAL PROCESSES TO FILM PRODUCTION

*Read to a joint meeting of the British Kinematograph Society and the Association
of Cine-technicians on February 28, 1951*

I. INTRODUCTION TO SPECIAL PROCESSES

T. W. Howard, F.R.P.S. (Fellow)*

PROCESS Projection has been extensively used for the past twenty years.¹

When a series of different set-ups is to be photographed immediately following one another, involving different camera viewpoints and angles of backgrounds, the mobility of the projection apparatus is a vital factor in making these changes quickly in order not to hold up the production unit. Sometimes it is possible to have two or even three projectors already aligned to accommodate the new camera set-ups, but more often than not it involves raising the projector some 10 ft. or 15 ft. in the air or shifting it across the stage, moving projectors, resistances, etc. Some studios have constructed large elevators to raise and lower their projection apparatus to any required degree. These are obviously very cumbersome and extremely expensive.

Projection Periscope

Fig. 1 shows a system which takes care of all but extreme movements, without moving the projector or its accessories from the studio floor.

It is not unlike the mirror system of the periscope; it allows the projector and all its attendant apparatus to remain in a stationary position, and merely by raising and lowering the top mirror, an apparent elevation of up to 17 ft. from the studio floor can be obtained. By rotating the boom carrying the mirrors, the picture can be shifted into any position within the compass of the arc described by the boom. With the projector tilted up and the periscope boom in its lowest position, an effect can be obtained of shooting from below

studio floor level. This system was used on the recent Metro-Goldwyn-Mayer British picture "The Miniver Story."

The ideal condition would be to have extremely wide angle lenses giving a minimum distance between projector and screen.² If a process were available which could fulfil the requirement of supplying a background to a moving foreground while requiring no additional stage space, then it would be the complete answer. Such a process does exist and has existed for some twenty odd years; it is known as the travelling matte process.

Dunning Process

In its original form as used by Dunning,³ as Fig. 2 illustrates, an ultramarine blue backing was used behind the foreground object, which was illuminated with yellow filtered light. In the camera an orthochromatic film and a panchromatic film were run through together bi-pack fashion, the blue sensitive film recording the background only and the pan film recording both blue backing and foreground image. From these two the travelling matte was made. This method was originally used in Hollywood by Dunning in conjunction with Pomeroy, and was also used to some extent in this country.

In the beam-splitting system of the Technicolor camera, the blue record is carried in the second gate. From this arrangement Laurence Butler and I, with the help of the Kodak Company and Technicolor, Ltd., evolved a method of travelling matte which was used for the first time in Korda's "Thief of Bagdad,"⁴ and is currently being used for

* M.G.M., British Studios Ltd.

some sixty scenes in Metro-Goldwyn-Mayer's "Quo Vadis." A modification of this method was used in earlier British black-and-white films, "Love on the Dole," "This England," and "Millions Like Us."

Limitations of Travelling Matte

The process of travelling matte has many advantages over process projection, and very much extends the scope of what can be done in composite photography, but it has certain limitations which are not present with process projection. One of these, which may at first appear quite insignificant, is the difficulty of reproducing glass. All of the usual moving background shots, train and car interiors, involving scenes through the window,

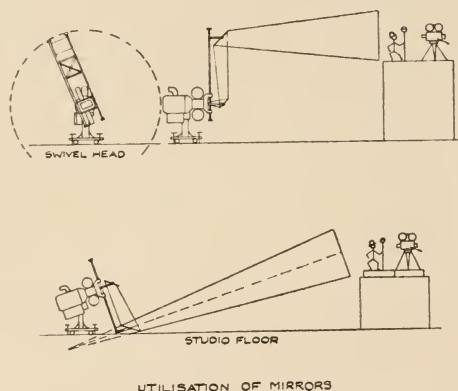


Fig. 1. The mobility of the projection apparatus.

camera tracks across the set. The view through the window appears to move off-screen at the same speed as the foreground window frame.

This defect we have accepted for years with process projection and have not found it unduly distracting; perhaps we have been conscious that the background seemed a little flat. When inserting a distant static background with the travelling matte process, the background does not move out when the camera is tracked, this giving a more natural appearance on the screen.

Travelling Matte in Technicolor

The successful use of the travelling matte process is very dependent on the close co-

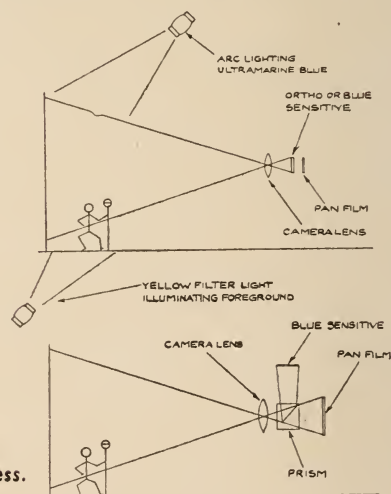


Fig. 2. The Dunning process.

will give a glass-free view of the background unless extreme care is taken with the foreground lighting.

One great advantage of this travelling matte process is the ability to introduce a foreground object actually into a background scene, as was done in the case of Sabu being made to appear to enter the miniature temple in the "Thief of Bagdad." In other words, one can establish contact between the foreground and background objects.

A defect with process projection which is minimised by the travelling matte process is the tendency of a distant background view on a static set-up to appear to shift out as the

operation of the cameraman and the laboratory in assembling the composite shot. The degree of accuracy required for the assembly of a travelling matte shot in black-and-white is high, and the process when used in Technicolor becomes exceedingly complicated, as Fig 3 shows.

To explain the exact procedure and to give all the technical data appertaining to the travelling matte process would take more time than is at my disposal to-night, but it is certainly one of the very important tools for film production, but it is not a cure-all! It must be remembered, also, that both foreground and background are dupes. Whilst

this is an advantage in matching foreground and background, it also has its disadvantages.

Matte Painting Process

In the painted matte process,⁵ the already photographed scene is taken to the matte painting studio, and there artists paint the required addition to the scene, this being carefully matted into the originally photographed scene, so that the final impression is of a composite whole. There are many variations on this process; moving clouds, water, smoke, or miniature people can be added during the painting—in fact, the scope is almost limitless.

One drawback of this method is that only a fixed camera set-up can usually be used.

manner, because no change of perspective is possible on a painted object, and therefore panning on a scene and joining on to a painting tends to reveal the flatness of the painting.

Use of Miniatures

Much ground covered by the matte painting process is also covered by the miniature.⁷ I use the word "miniature" in preference to models, because here there can be a great deal of confusion. A miniature is usually a reduced scale reproduction of buildings, either interior or exterior, or perhaps a complete landscape, whereas a model in a film production is usually that article used by the Art Department or Production Department

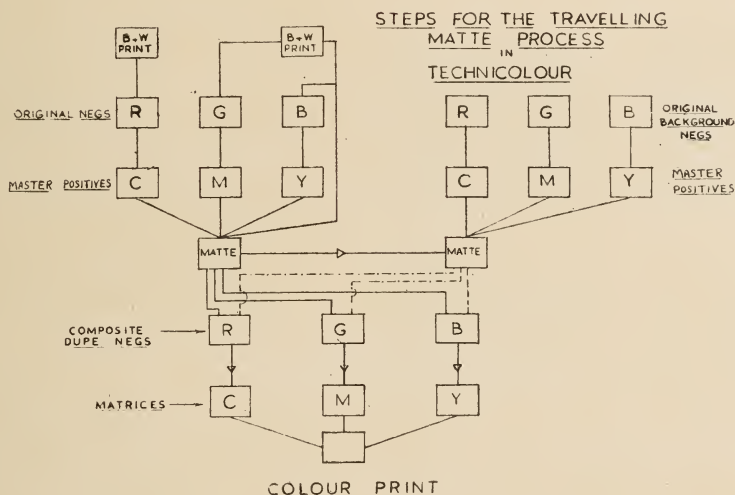


FIG. 3

Geared heads on the camera have been employed to match movement on the painting with a photographed scene, by gearing the movement of the camera through Selsyn motors controlling frequency generating amplifiers; the output from the amplifier is recorded on either disc or film. Then by playing back the recording through an amplifier controlling the Selsyn motors the exact original movement of the camera head is imparted to the matte painting camera head.⁶ This can be applied in only a very limited

to illustrate the set or layout of a sequence. A miniature, then, is a reduced scale reproduction of an object which is going to be photographed, whilst the model is used only for guidance in design of set construction.

The miniature can be used as either a foreground piece or a background, or in some instances as a complete set. When used as a foreground piece, its only justification is if camera movement is required.

An example of this was one of Sir Alexander Korda's early films, "Rem-

brandt," where the full-size set piece showing the main waterfront with its quaint Dutch buildings was topped up by miniature. The majority of the upper part of this scene was erected close to camera and aligned to join up with the full scale set. The miniature had its snowclad roofs and ran from the eaves down to the first floor level on most buildings. The camera was set up to pan, using a nodal head, along this miniature and full scale set piece. This would not have been possible as a matte painting, due to the change of perspective on the foreground miniature, which would not have occurred in the flat painting.

The construction of these miniatures calls for a high degree of skill and is a lengthy process, and consequently is also very expensive. It is sometimes absolutely essential

can be executed. Sections can be masked and others substituted. An example appeared in Coward's "Brief Encounter," where Celia Johnson is sitting in an armchair and the background is made to change, leaving her still in her chair in the foreground. This process has numerous applications. Let me try to describe one.

If, for example, the Director wishes to establish the locality of his story by showing the exterior of a building as his characters arrive. They enter the building, but the camera tracks right up the face of the building to a fourth floor window which it approaches in time to see the entry of the characters into the apartment; the camera then tracks into the room with them.

This shot is photographed in three sections. Section No. 1: characters arriving



Fig. 4

Travelling Matte Process

- A. Print from the original foreground against a blue backing.
- B. Positive Matte.
- C. Negative Matte.
- D. Print from composite Technicolor dupe negative.

to use miniatures, as in the case of "The Man Who Worked Miracles," where in the "end of the world" sequence all the buildings, trees, and, in fact, the whole earth itself, had to break up and fly into the air when gravitational pull was stopped by the miracle man; or more recently in "Samson and Delilah," where the temple collapses.⁸

A process which has fallen into disuse in this country, presumably only for lack of knowledge as to how to apply it, is that of projection printing.⁴

The projection printer is really a process projection set-up in miniature, but with the added advantage that the projected picture can be stopped at any required frame for as long as the photographer requires. This means that complicated split-screen shots

and entering the building. Section No. 3: the characters are photographed through the window, tracking the camera into the room. These two sections are developed and prints are made from them. The missing Section No. 2 consists of the whole front of the building. This can be a still picture of an actual building or a painting. The picture of the building is placed in front of the screen, leaving a space in which to project the entrance scene, Section No. 1.

The camera is now set up to copy Section 1 which is projected on to the screen. Then as the characters enter the building the camera is pulled back to reveal the still picture of the exterior. Having pulled back the required amount, the camera is now raised

to give the impression of going up the outside of the building.

As soon as the camera clears the moving picture, the machine is stopped and Section No. 3 is placed in the projector. At this point the camera can be restarted and the movement continued until the edge of the

fourth floor coping is about to enter the camera angle. The machine is stopped again, the projector is coupled, and No. 3 scene is projected into its prepared position through the still picture. The machine is restarted and the camera is tracked in to copy only the projected picture.

II. THE CHOICE OF PROCESS

Alfred Junge (Fellow).

AMONG the many specialised processes used in film production are the Dunning Process,³ the Schüfftan Process, Fore-ground Models, Background Models,⁷ Glass-shots, Matte Paintings,⁵ Split-Mattes, Optical printing,⁴ Perspective models and sets,⁹ fixed and moving Back Projection,¹ Transparent Backings, Photo Backings, etc. Very often two or more of these processes are combined with real shots. In fact, so many different combinations are possible that one of the main problems is, or should be, which one to use.

Technicians are, I believe, in some danger of using processes or trick shots for their own sake, instead of asking themselves first, "Is this really the best method of achieving the required result?" By best is meant both most economical and convincing; both these factors must play a part in the calculations. Exactly what proportion is given to each must, of course, depend on individual circumstances.

Let it be said straight away that I have no prejudice against any of the processes named. I have used them all many times, and shall do so again.

It is my belief that motion pictures should be first and foremost just that—motion pictures. Dialogue, music and all other sounds are very valuable additions, but all the same of secondary importance. The patron goes to see a film, not to hear a story—and the first and last appeal should always be to the eye.

Drama without Danger

In the film "I Know Where I'm Going,"

produced in 1945, a scene was required where a boat is nearly sucked into a whirlpool. A location unit went to the Isle of Mull in Scotland to try to obtain shots of a real whirlpool. This proved most unsuccessful. The whole process was very dangerous, although it did not give that effect in the rushes.

To get the dramatic effect special processes had to be used—and what I consider was a very real effect of danger away from all danger was created. In fact, the effects could be made so real and dramatic just because there was no danger, because we had control of the camera, of light, of wind and weather, and of the actors.

First of all a rocking device which could carry a boat and which allowed every movement required was constructed (Fig. 5). This device was mounted on a turntable so that the boat could be quickly turned at different angles to the screen. The rocking movements were controlled electrically from near the camera. The waves—as required, big or small with the horizon and the clouds, the water-spouts, the approaching rain squall, and the whirlpool, were all artificially produced and photographed for back projection plates in the water tank at Denham Studios. Different sizes of model boats with their model figures were made and shot.

The Whirlpool

To construct the whirlpool was the biggest problem of all. The solution is shown in Fig. 5a. Inside the Denham tank was put a round emergency water tank, about 30 ft. in diameter, a few inches under

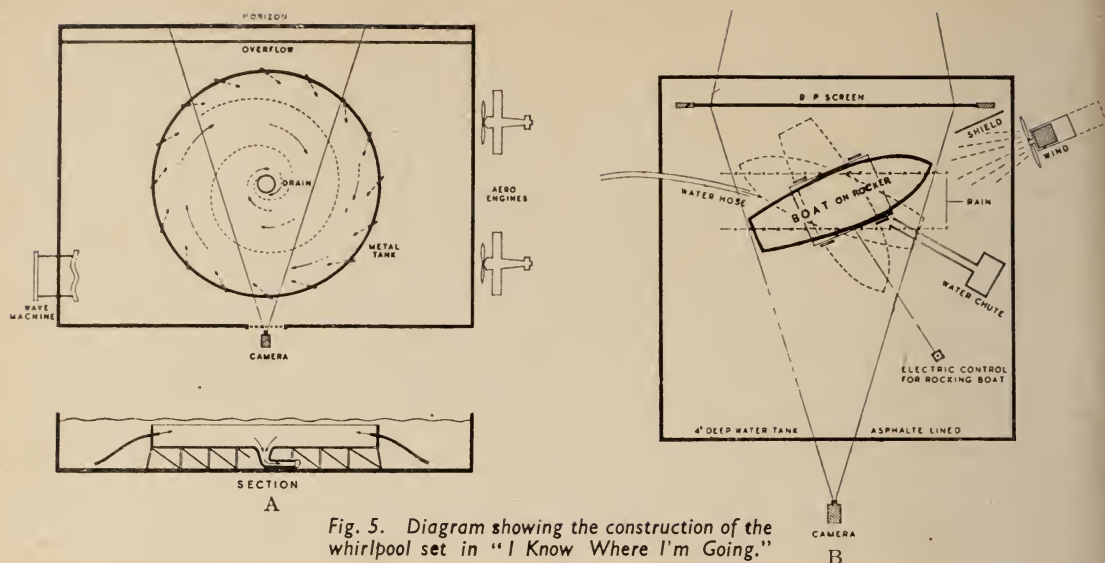


Fig. 5. Diagram showing the construction of the whirlpool set in "I Know Where I'm Going."

water level. Through the iron wall of this tank were fixed sixteen nozzles connected to fire hoses and six powerful fire engines. Water was sucked out of the tank through a hole in the bottom and pumped in again with tremendous force through the side, and was thereby set rotating. Dry ice was then thrown in to produce a boiling effect. This was helped by several small rubber hoses

fixed to the bottom of the tank, through which air was blown to produce bubbles. Finally, fire-fighting foam was spread on the water. Then two hand-operated wave machines were set in motion on the left and two aeroplane engines on the right, acting as strong wind machines to blow with gale force on the water and produce the waves.

This, I consider, was a good example of



Fig. 6. Still from the whirlpool set in "I Know Where I'm Going."

how trick-shots, in this case back projection, models, glass-shots and optical printing, were brought together with real shots to build up a climax which could not be achieved by other means.

Photographic Backings

Two short scenes from "A Canterbury Tale" will now be considered.

The interior of the Cathedral in this film was a difficult shot, as it had to allow a long camera movement. A combination of photo cut-outs and a studio set was used. The



Fig. 7. The set of Canterbury Cathedral in "A Canterbury Tale."

second scene, tracking through the Bell tower close to the Rose Windows and looking over the roof of the Cathedral down to Canterbury, was a big model shot combined with a photo backing. The plaster bells were rung by bellringers of St. Paul's Cathedral, their movements synchronised to a gramophone record. The photo for the backing seen through the window was, of course, specially taken for this shot.

Use of Painted Mattes

Next is an example from "Black Narcissus," in which the application of matte-

paintings in building up the desired atmosphere was invaluable. An expedition to India or Butan would have been very tiring, very expensive, and the result much less effective.

"A Matter of Life and Death" was an interesting picture, in that the action takes place on two contrasting planes—here on earth and in an imaginary world. Life on earth is in colour, life in the other world in black-and-white. The transitions from black-and-white to colour and *vice versa*



Fig. 8. The set constructed for "Black Narcissus."

created problems of special interest, as, of course, the avoidance of any kind of jar or break was wanted. Process shots, montages, and all kinds of tricks were widely used.

Choice of Method

I think you will be convinced that I do not despise specialised processes. Examples have been shown of the application of B.P. and models; of matte-paintings; of models and cut-outs in combination; and finally of triple exposure over painted background and travelling matte in colour.



Fig. 9. Scene from "A Matter of Life and Death."

Nevertheless, in summing up I return to the warning with which I began this talk. All the trick-shots shown were used for one of two good reasons: either because the effect wanted could not be obtained in any other way, or because that other way was too expensive or dangerous.

Independent Frame¹⁰ is a method of planning whole productions mostly on trick shots. Here was a clear case of falling in love with an idea for its own sake—and, by falling in love with it, losing sight of its limitations. Similarly, when the Schüfftan process was new, every producer wanted the process to be used practically all the time, no matter whether it was desirable or not.

Attention has recently been drawn to a

development of the Travelling Matte process.¹¹ The process has been known for years. Perfect travelling mattes can replace B.P. to a certain extent; they save studio space and have some other advantages. But they have disadvantages as well. If the process can be improved, so much the better. I shall be the first to welcome the improvement. But let it not be imagined that they will suddenly revolutionise all our film-making.

What is needed more than anything else in the film industry is the right use of the right process at the right time. Very often the simplest solutions are the best, and economy and artistry go together.

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NOTES ON THE ACCURACY OF MEASUREMENTS OF THE LUMINANCE AND ILLUMINATION OF KINEMA SCREENS

H. H. W. Losty, B.Sc.* and F. S. Hawkins, Ph.D., F.R.I.C. (Fellow)*

THE illumination and luminance of a kinema screen may be measured by a number of methods which divide broadly into two classes, visual and photo-electric. In this paper the convenience with which they may be used, and the accuracy which can be attained, particularly when the measurements are made in a kinema, are discussed.

1. Screen Luminances

The luminance of the screen varies widely from kinema to kinema ; measurements in thirteen representative kinemas by the method given in British Standard No. 1404 gave values ranging from 4.5 to 29.0 ft.-lamberts. In addition, in any one kinema the luminance can easily fall to half its maximum value over a period of time, as a result, for example, of the depreciation of the mirror in the arc lamp, or the fall in reflective power of the screen when its surface is darkened by dirt and smoke. However, the projection of the picture appears to be satisfactory over a wide range of screen luminances ; the above British Standard recommends a range of 8-16 ft.-lamberts.

Considerations such as those given above have been discussed in a previous paper,¹ in which it has been shown that for everyday purposes such as equipment maintenance, determinations of the highest accuracy are not required, and a photometer of moderate precision may be used. Such an instrument may indeed have compensating advantages like portability and robustness.

2. The accuracy of a portable visual photometer

Certain instruments suitable for everyday

use are visual photometers, but it has been suggested that it is difficult for an untrained observer to balance the two fields of view correctly, owing to the difference in colour between the light from the screen and from the comparison lamp.²

In order to discover how great an error was likely to arise from the use of such a meter some tests were made, by both skilled and untrained observers, using as a photometer a Salford visual exposure meter. In this instrument there is still a colour difference when it is used to measure a screen illuminated by a carbon arc, although the light from its comparison lamp is filtered through a "day-light" filter.

A perforated matt white kinema screen was illuminated by a typical projector, equipped with a high intensity arc lamp, burning 8 mm. positives, 7 mm. negatives at 55 amperes, and twenty different observers measured the luminance of a particular small area of the screen with the meter. Simultaneously, readings of the luminance of the same area were taken with a photoelectric telephotometer, a laboratory instrument capable of measuring screen luminance within 1%. The observations given in Table I fall into two groups. For the first group of 11 observers, the screen had a luminance of 14.5 ft.-lamberts ; for the second group its luminance was in the range 17.1 ft.-lamberts except for one reading of 14.5 ft.-lamberts. Each observer made three separate readings, and these are tabulated below as a percentage of the true screen luminance as measured by the telephotometer.

* Research Laboratories of The General Electric Company, Limited, Wembley, England.

Table I

Screen luminance, measured by Salford exposure meter, expressed as a percentage of the true luminance

Observer No.	Individual readings with Salford meter			Mean
	per cent.	per cent.	per cent.	per cent.
1	90	89	86	88
2	74	74	85	78
3	90	84	83	86
4	91	81	83	85
5	82	81	76	79
6	81	75	88	81
7	100	103	113	105
8	80	74	80	78
9	88	90	89	89
10	80	75	82	79
11	87	85	82	85
Mean : 85				
12	102	105	85	97
13	88	83	84	85
14	84	80	88	84
15	111	91	97	100
16	102	100	102	101
17	94	104	99	99
18	100	98	96	98
19	93	93	98	95
20	98	115	88	100
Mean : 96				

In the above tests, observers Nos. 2, 3, 9 and 11 were experienced in the use of photometers; the remainder were entirely unskilled in the art and most of them were using a photometer for the first time. These results, when summarised, can be grouped as follows:—

8 observers are within 5% of the true value (100%).

6 more are within 15%.

2 are within 20%.

4, the remainder, are within 22%.

The mean values of each group differ from 100%, and if the individual values are grouped around the mean, then the above summary becomes:—

12 observers are within 5%.

5 are within 10%.

2 are within 15%.

1 is within 20%.

Giving results which are a little more closely grouped together because this eliminates any systematic error which may exist between the photometers.

The mean value of the skilled observers' readings is 84.8%, practically the same as the group mean of 85%.

These observations show that with this particular visual instrument even an entirely unskilled observer will get results within 20% of the true value and higher accuracy can be obtained with a little practice. For most everyday purposes greater accuracy than this is not required.

3. Photoelectric methods using a small angle of acceptance

Measurements of screen luminance having a higher accuracy than those described above are sometimes required, particularly in laboratory work. A primary condition for accuracy is that the luminance of the portion of the screen which illuminates the meter must be constant over the whole of its area when measured from the position occupied by the meter. This quantity changes rapidly with angle for a preferentially reflecting screen, therefore accurate measurements can be made only if the portion of such a screen under test subtends a very small solid angle to the measuring instrument.

The telephotometer developed for measurements of the beam intensity of searchlight projectors³ is a photometer which receives light from a small solid angle, and it has therefore been adapted for screen luminance measurements. It consists of a telescope with an aperture plate placed in its image plane, and a photocell behind the aperture. If the telescope is set up a suitable distance away, then light from only a small portion of the screen will pass through the aperture in the plate and energise the photocell. The area of this portion of the screen is determined by the magnification of the telescope and the size of the aperture; it has been found that a roughly circular area about 10 sq. ins. in extent is suitable when

The telephotometer is calibrated by setting it to view a test plate of known reflective properties illuminated by a sub-standard tungsten lamp whose intensity in the direction of the test plate is also known. The instrument is then directed at the point on

Screen illuminations are comparatively easily measured by a number of well-known methods, and if it were possible to obtain a simple method of measuring the luminance factor then the values of screen illumination could readily be converted to screen luminance.



ance. The luminance factor is the ratio of the luminance of a reflecting or transmitting surface, viewed from a given direction, to that of a perfect diffuser receiving the same illuminations. An attempt was made to estimate the luminance factor of a screen by holding up against it a series of cards of known luminance factor, and selecting the card which most closely matched the screen. The cards, supplied by Kodak, Ltd., were

coated with a matt surfaced bromide emulsion which was exposed by increasing amounts to give a series of surfaces of decreasing luminance factor.

It was found possible to obtain a fairly satisfactory match against a perfectly new matt white screen, but matching was very difficult when the screen had acquired the yellow tinge which comes with use. The method, too, is not immediately applicable

5. Calculation of total luminous flux incident upon a screen

The total luminous flux incident upon the screen is a useful single figure for the comparison of the light output obtained with different conditions of projection. It may be obtained rapidly and with adequate accuracy from the twenty-three standard measurements of illumination (Fig. 1) by the following method:—

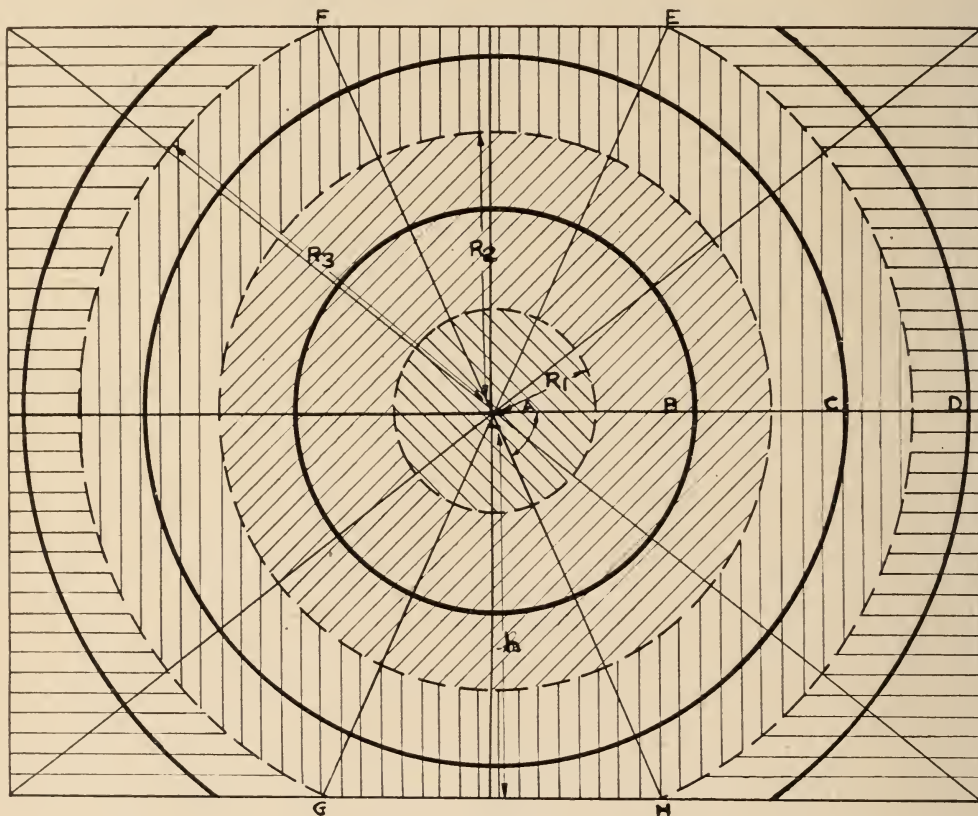


FIG. 2

to beaded and similar preferentially reflecting screens.

It could only be used if it were possible to obtain a series of standard surfaces having luminance factors greater than that of a perfect diffuser, or if, as suggested by Reeb, the luminance of the portion of the screen under examination were reduced by holding a neutral filter of known transmission in the beam. The colour difficulty still remains, however.

Fig. 1 shows that the illumination readings are taken round three concentric circles. In Fig. 2 these circles are shown by heavy lines and the dotted lines show how the screen may be divided into four zones, A, B, C and D (each shaded differently in Fig. 2), such that the mean illumination at the centre and round each of the three circles may be taken as the average for the zone that contains it. To obtain an approximate value for the lumens incident on the screen all that remains

to be done is to multiply the area in square feet of each zone by the appropriate average illumination in lumens per square foot and add these four results together. To quote an example, to calculate the area of each zone, first calculate the area of each corresponding zone on the viewing graticule¹, the dimensions of which are shown in Fig. 2.

The area of zone A = $\pi R_1^2 = \pi (0.5)^2 = 0.785$ sq. ins.

The area of zone B = $\pi (R_2^2 - R_1^2) = \pi (1.4^2 - 0.5^2) = 5.372$ sq. ins.

The area of zone C = area of sectors O E H and O F G + area of triangles O E F and O G H - (area of zone A + area of zone B) = $4 (\frac{1}{2} R_3^2 \theta) + 2 (\frac{1}{2} GH \times h) - 6.157$, where θ is in radians,

and $\sin \theta = \frac{h}{R_3} = \frac{1.9}{2.1} = 0.907$

$\therefore \theta = 1.1345$ radians

and $GH = 2 R_3 \cos \theta = 2 \times 2.1 \times 0.422 = 1.775$ ins.

\therefore area of zone C = $2 \times 1.1345 \times 4.41 + 1.9 \times 1.775 - 6.157 = 7.283$ sq. ins.

Area of zone D = area of screen - areas of zones A B C
 $= 3.8$ ins. \times 5 ins. $- 13.440$
 $= 19 - 13.44 = 5.560$ sq. ins.

Summarising:—

Table II

Zone	Area in sq. ins.
A	0.785
B	5.372
C	7.283
D	5.560

Having thus obtained the area of each zone on the graticule, to obtain the actual area of the corresponding zones of the screen in sq. feet these Area Factors as they may be called are multiplied by the constant

$$\frac{(\text{width of screen in ft.})^2}{5^2}$$

The area of each zone on the screen so obtained is then multiplied by its average illumination in lumens/sq. ft. This gives the luminous flux reaching each zone in lumens, and summing the flux reaching each zone gives the total luminous flux reaching the screen.

Thus, in a certain kinema, the screen was 23 ft. 9 ins. wide, and the illumination readings given in Fig. 1 were obtained. They give figures for the luminous flux as shown in Table 3.

6. "Saturation" of the photocell

Rectifier type photocells are frequently used for the measurement of screen illumination, and such measurements are normally made with the projector shutter running and with no film in the machine. The photocell is therefore illuminated by a flashing light whose intensity during the period of each flash is approximately twice as great as the average intensity, which is also the intensity seen by the eye and recorded by the microammeter of the illumination meter.

Although the microammeter appears to register a steady current, it is not, in fact, receiving such a current from the photocell; it is receiving pulses of current corresponding to the flashes of light passed by the shutter. These are integrated by the micro-

Table III

Zone	Area factor	Area of this zone of screen	Mean illumination	Luminous flux
A	0.785	17.7 sq. ft.	25 lumens/sq. ft.	443 lumens
B	5.372	121.1 " "	23.3 " "	2820 "
C	7.283	164.0 " "	19.1 " "	3140 "
D	5.560	125.5 " "	14.1 " "	1770 "
Total luminous flux				8173 "

ammeter, whose natural period of oscillation is long compared to the duration of the pulses, and so the meter indicates the mean current. It is, therefore, the current given by the photocell during the flash which determines the microammeter reading, and during this period the illumination falling on it is approximately twice as great as that indicated by the meter.

It is well known that the photoelectric current given by rectifier cells is proportional to their illumination only over a limited range. If the illumination rises above the values within this range, then the photocell begins to "saturate" and gives less current than would be expected; the proportionality between light and current no longer exists. The range over which these two quantities are proportional depends, amongst other things, upon the electrical resistance external to the cell. For an example, in the case of one particular cell and microammeter it was from 0.80 lumens/sq. ft.

Meters using rectifier cells are normally calibrated by a steady light source; it therefore follows that when these meters are used to measure the screen illumination given by a projector whose shutter is running, their calibration is valid only for approximately the lower half of their scales. The exact portion of the scale for which such a calibration holds is determined by the form factor of the waveform obtained by plotting the instantaneous values of illumination against time. If this factor is small, then only a correspondingly small part of the scale calibration is valid; when the factor rises to unity (*i.e.* when the

meter is illuminated by steady light) then the calibration holds for the whole of the scale. Thus the meter described above, if it were used to measure the illumination of a small kinema screen, would, owing to these "saturation" effects, give a low value when the mean illumination of the screen exceeded about 40 lumens/sq. ft., although in a steady light the accuracy of the meter would not be impaired until 80 lumens/sq. ft. was exceeded. In this particular instrument the error would be between 5% and 10% for a full scale deflection. Screen illuminations are steadily becoming higher as new equipment is designed; there are projectors that will now give an illumination of 40 lumens/sq. ft. on an 18 ft. screen when there is no film in the gate and the shutter is running. Illuminations higher than this have been recorded in some of the smaller theatres.

Such illuminations appear to be higher than they need be; the maximum luminance of 16 ft.-lamberts required by British Standard 1404 can normally be achieved by an incident illumination no greater than 24 lumens/sq. ft.

The level of illumination at which the saturation error of the meter becomes of practical importance depends upon the design of the meter. In the case of the instrument described above the error would not be of great importance, even at 80 lumens/sq. ft. It is possible, however, to construct a meter in which the error is larger and it is therefore preferable to calibrate these meters with a flashing light whose waveform is that of the illumination they are intended to measure.

REFERENCES

1. *Brit. Kine.*, 17, No. 4, Oct., 1950, p. 118.
2. *J. Soc. Mot. Pic. & Tel. Eng.*, 38, No. 1, Jan., 1942, p. 74.
3. *I.E.S. Searchlight Symposium*, 1948.

MANCHESTER SECTION

The Manchester Section are arranging a series of interesting lectures covering the activities of the Theatre Division and the 16mm. Film Division. This is the first time the Manchester Section has included 16mm. subjects.

The meetings will be held on the first Friday in each month, from October 1951 to April 1952, inclusive. They will commence at 7 p.m., and will be held in the Lecture Hall of the Manchester Association of Engineers, Booth Street, Manchester.

THE MANUFACTURE OF PHOTOGRAPHIC CHEMICALS

EARLIER this year, the editors of a number of photographic journals were invited to the Dagenham (Essex) factory of Messrs. May and Baker, Ltd., and were shown round the research and testing laboratories as well as the manufacturing plants responsible for producing a wide range of chemicals.

First, the visitors inspected the test laboratories, where both raw materials and finished products undergo routine tests. In these laboratories stringent tests are applied to the finished products to ensure the maintenance of a high standard of consistency.

Instruments for Testing

Both chemical and photographic methods of testing are employed. Methods of analysis used include the spectro-photometer (transmission curves, often in the ultra-violet region, provide an indication of the constituents of substances); the polarimeter (which makes use of the principle that certain crystalline substances rotate the plane of polarised light); and the pH meter.

Instruments for photographic testing have been largely made in the company's own instrument works. A sensitometer was seen of the intensity-scale type which makes use of a silver wedge as the modulator. A photo-electric densitometer is used and adapted to a null reading instrument for accuracy, while an adjoining instrument was shown for the measurement of the Callier coefficient (a relationship between the densities of a photographic image measured by specular and diffuse light).

At a later period, a visit was made to the research laboratories in which much of the apparatus needed for research and development of photographic products was examined.

Photographic Chemicals

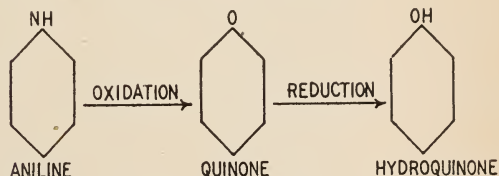
The visitors were also conducted round that part of the factory devoted to the manufacture of photographic chemicals—for some of which the May & Baker organisation are the sole manufacturers in this country. The

production of the following chemicals was inspected:—

Hydroquinone



The basic raw material for this developer is aniline, which is oxidised to quinone, and the latter reduced to hydroquinone.



When the oxidation of the aniline is complete the quinone is steam distilled from the reaction mixture into an acidified suspension of finely ground iron, in which an instantaneous reduction to hydroquinone takes place. The resulting dilute solution of hydroquinone is filtered from the excess iron and treated with a stabiliser before being concentrated by passage through a continuous evaporator.

The concentrated solution is treated with decolourising charcoal, then filtered, and allowed to crystallise, with agitation, in a series of cooled glass lined pans. Finally, the hydroquinone is collected on a hydro extractor, then dried by a stream of hot, filtered air.

p-Amino-Phenol



p-Amino-phenol is manufactured from p-nitro phenol by reduction in suspension of

finely ground iron. This reduction is accompanied by copious frothing, which is controlled by the judicious application of a spray of water.

On completion of the reduction the batch is transferred to a second vessel in which it is neutralised, then filtered through a plate and frame filter press to remove excess iron. The hot solution of p-amino-phenol is then treated with decolourising charcoal before being filtered into a stirred crystallising vessel to which stabiliser has been added to retard oxidation. The p-amino-phenol is finally collected on a hydro extractor and rapidly dried in a stream of hot air.

stallisation of a previous batch. The aqueous layer so formed is separated and its pH adjusted to remove any unchanged p-amino-phenol, which is removed by filtration.

Metol is precipitated by the addition of sodium sulphate after a further adjustment of the pH and is collected on a hydro-extractor; the aqueous liquors from this operation still contain some Metol, which is recovered.

The two crops of crude Metol are combined and recrystallised from distilled water, the white, crystalline finished product being dried in a stream of hot filtered air, and the aqueous mother liquors being used for the extraction of the subsequent batch.

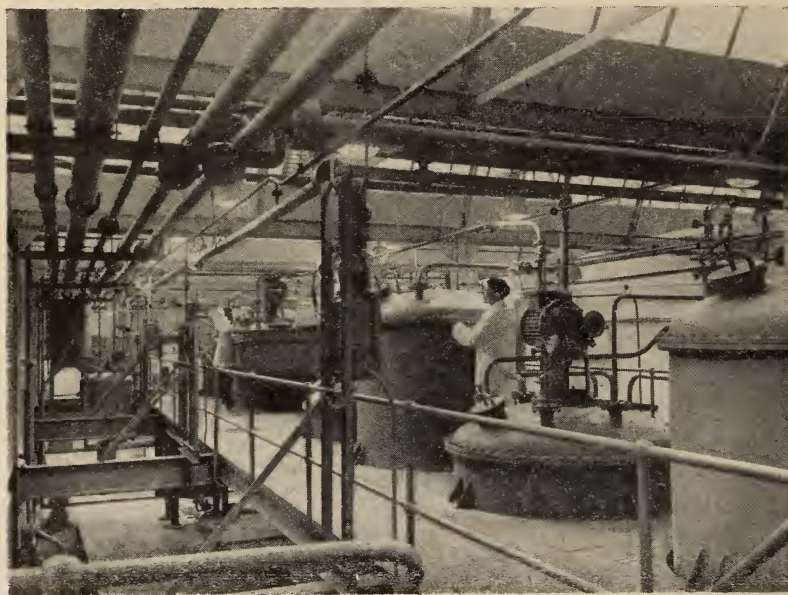
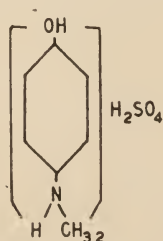


Fig. 1. A typical chemical production shop.

Metol

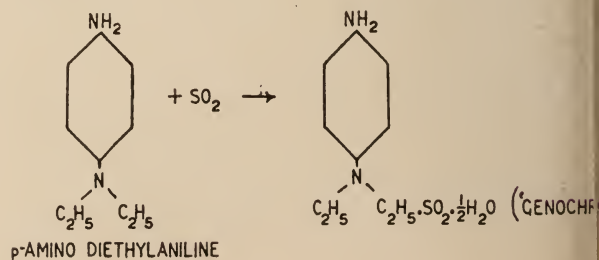
p-Amino-phenol is methylated with dimethyl sulphate and the resulting crude



material is extracted with an aqueous solution of Metol obtained from the final recrystallisation of a previous batch.

Genochrome

This stabilised colour developer is used in subtractive colour film processes and is manufactured by a synthesis represented as follows:—



Freshly distilled p-amino diethylaniline is reacted with a solution of sulphur dioxide in an organic solvent, in an atmosphere substantially free from air, to produce the sulphur dioxide compound of p-amino diethylaniline, which is isolated, dried and packed under the trade name of "Genochrome."

"Genochrome" is stable to aerial oxidation, both in the solid state and in aqueous solution. The solid may be stored for two years without deterioration.

Ether 720 B.P. $C_2H_5 \cdot O \cdot C_2H_5$

Ordinary diethyl ether is made by the clas-

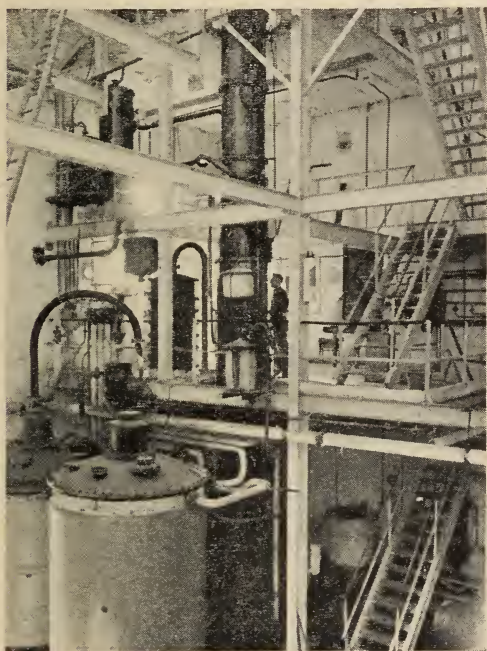
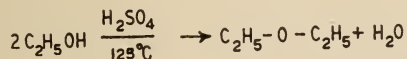


Fig. 2. Barbet column in ether manufacturing plant.

sical method, ethyl alcohol reacting with sulphuric acid, by a continuous technique.



Theoretically, the acid lasts indefinitely and a steady feed of alcohol under carefully controlled conditions permits a continuous off-take of B.P. quality ether at the exit end of the plant. In practice, due to small losses of acid by entrainment, reduction to sulphur dioxide, etc., the acid does occasionally need

fortifying and at rare intervals complete renewal.

Essentially, the plant consists of a lead lined mild steel reactor, containing the sulphuric acid, which is maintained at $125^\circ C$. by steam through lead coils; the ethyl alcohol is fed to the reactor and a mixture of vapours consisting mainly of diethyl ether, some alcohol, and water, passes to a vessel in which it is scrubbed with dilute caustic soda solution. These vapours then pass into the main fractionating column and partial condenser for removal of most of the alcohol and water, thence through the top fractionating unit to reduce the alcohol content to within the specified limit and finally to the main condenser via the analyser.

The partial condenser serves to reflux the bulk of the alcohol into the lower column and thence, under control, back to the reactor; the analyser serves to reflux a proportion of good quality ether to the top fractionating column, thereby ensuring a steady, good quality off-take of product. From the main condenser, the ether is run by gravity into a series of 3,000-gallon underground storage tanks outside the building; in these tanks a small quantity of stabiliser is added during filling to suppress the formation of peroxides.

All electrical fittings in the vicinity of the plant are of the flame-proof type, or installed outside the buildings, and even the lights are so sealed off that lamp renewals are made from the outside only, to minimise fire risks.

Potassium Bromide. KBr.

This fine chemical is manufactured by the interaction of bromine and potassium carbonate or hydroxide in the presence of a suitable reducing agent.

The reaction is carried out in steam-heated cast iron vats where liquid bromine is added, with suitable precautions, to the alkali dissolved in water. The resulting solution of potassium bromide is then treated for the removal of impurities such as sulphate, bromate and foreign metals.

The purified liquor is subsequently concentrated to the desired specific gravity, after which it is filtered into large tile-lined baths

where crystallisation continues over a period of days. The mother liquors are then pumped off into the storage vats, while the potassium bromide is collected on a hydro-extractor, and then dried by means of hot, filtered air.

The final stage of the process consists of grading for size and this is accomplished by means of mechanical sieves, after which the product is put "in bond" until the analytical examination has been completed.

Potassium Iodide. KI

This salt is made by a process analogous with that used for potassium bromide, but substituting elemental iodine for bromine. On completion of the reaction, the solid impurities are removed by vacuum filtration, after which the liquors are pumped to purification vats where the remaining impurities, such as sulphate, iodate and foreign metals, are removed.

The next stage of the process consists of concentration of the purified liquors in steam-heated evaporators until the correct crystallisation strength has been achieved, after which they are filtered into glass-lined pans to crystallise.

The supernatant liquors are then pumped

off into storage vats and the solid potassium iodide collected on a hydro-extractor in order to remove adhering liquor. The product is finally dried by passing a current of hot, filtered air directly through the crystalline mass.

The final stage of the process consists of grading into various sizes by passing the dried material over sieves.

Amfix Solution

This product is made from ammonium thiosulphate solution manufactured at Dagenham. By the careful adjustment of strength and pH and the addition of stabilisers, each batch is filtered prior to analytical testing.

Instructional Films

The production of photographic chemicals is, of course, a comparatively small part of the work of May & Baker, whose name is universally known for fine quality pharmaceutical chemicals and medical products. For instruction in the use of these substances, and in general aspects of medicine, the sub-standard film is widely used, and a number of such films are available for loan to medical, pharmaceutical and nursing audiences.

R. H. C.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

IMAGE GRADATION, GRAININESS AND SHARPNESS IN TELEVISION AND MOTION PICTURE SYSTEMS, Part I: IMAGE STRUCTURE AND TRANSFER CHARACTERISTICS

Otto H. Schade, *J. Soc. Mot. Pic. & Tel. Eng.*, Feb., 1951, p. 137.

The physical quality of motion picture and television images is determined by the transfer characteristic, the standard deviation or signal-to-fluctuation ratio, and the detail flux-response characteristics of the system. The performance of typical systems and system combinations is illustrated by examples permitting numerical comparison. The analysis of fluctuation levels ("noise") in photographic processes, based on sampling theory, includes an evaluation of the sine-wave frequency spectrum of the deviation as modified by the "aperture" processes of the system. The sine-wave response characteristics of typical apertures are developed as well as an accurate method of determining the equivalent "resolving aperture" (point image) of practical devices from sine-wave response measurements. A new system of rating image-forming devices is thus developed permitting precise evaluation and comparison of components as well as of complete systems including the eye. Part I discusses the transfer characteristics of motion picture and television systems. Parts II and III, to be published at a later date, will contain an analysis of signal-to-fluctuation ratios and detail contrast.

AUTHOR'S ABSTRACT.

BIBLIOGRAPHY ON HIGH-SPEED PHOTOGRAPHY

J. Soc. Mot. Pic. & Tel. Eng., Jan., 1951, p. 93.

Contents: General, cameras, lighting, oscillography, schlieren, technical and techniques and X-ray.

COLORIMETRY IN COLOUR KINEMATOGRAPHY

A. Lennartz, *Film-Technikum*, I, No. 9, Dec. 15, 1950, p. 159.

In order to obtain true colour rendering, especially when exposures of the same scene are taken at different times, it is recommended to measure objectively the following data: 1. Light intensity. 2. Colour of the light. 3. Sensitivity of the colour filter.

This method is preferable to trying to obtain true colour rendering during the negative-positive process. It also enables one to use the same colour film for daylight and for artificial light exposures, by applying appropriate filters.

R. S. S.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library

CAME THE DAWN by Cecil M. Hepworth,
Hon.F.B.K.S., Hon.F.R.P.S. 207pp. Phoenix
House, 16s.

Soldiers, statesmen, industrialists, and, indeed, craftsmen in our own industry, recognise the value of historical knowledge as an aid to strategy. Historical aspects of British film production have lately been dealt with in several books, and Cecil M. Hepworth's autobiography is one of the most important.

Here is a narrative of absorbing interest, full of information on production technique in the silent days, given with the authenticity to be expected from such an author. Mr. Hepworth's style of writing is modest and unassuming and he approaches film making as a craft rather than as an art.

with his contemporaries' work in dark studios at that time.

Mr. Hepworth's laboratory contained one of the first automatic developing machines—his own invention—but, he admits, "I had all along been intending to make the developing machines complete by linking them with drying-banks, operating in close conjunction with them; but that project had somehow got postponed in the more exciting affairs of making film pictures and running a business." Drying was carried out in a primitive manner, by hanging film from the ceiling of a heated room. Shortage of staff during the 1914-18 war compelled him to complete his drying-machine scheme, in which he was assisted by Alma Taylor and members of his stock company of actors, who worked at lathes on days when they were not required to act!



Proposed new additions to the Hepworth Studios, 1922.

The pages of this book reveal the author's tremendous fund of knowledge of every aspect of film production, ancient and modern, and vividly describe the conditions under which some of the finest films of the silent days were made. Mr. Hepworth was the last important producer (apart from Charles Chaplin) to make use of daylight studios, and even in 1922 planned to build a new plant having six glasshouse stages, auxiliary arc lighting and a diesel-electric power house. "I clung to the archaic idea of using daylight as far as possible," he confesses—but the technicians of to-day will probably support his decision, bearing in mind that orthochromatic negative was the only stock available. And this opinion is confirmed by comparing Hepworth's photography

The text of this book is filled with names familiar to all of us, including Tom White, Paul Kimberly, Will Barker, Geoffrey Faithfull, the late Robert Paul, and many other members of the B.K.S. It is fully illustrated with stills, plans and most delightful drawings by the author. We congratulate an Honorary Fellow of the British Kinematograph Society on his enthralling book.

I have one suggestion only to offer for future editions. A short statistical appendix would be valuable. Details of costs of production, shooting time taken per picture, titles and cast credits, together with collated technical information on the Hepworth plant, size of stages, etc., would be well worth recording.

BAYNHAM HONRI.

THE PHOTOGRAPHIC STUDY OF RAPID EVENTS by W. D. Chesterman. (*Monographs on the Physics and Chemistry of Materials*). 158 pp., 32 plates. Oxford at the Clarendon Press, 1951, 21s. net.

This new book by Mr. W. D. Chesterman will be welcomed by all technicians who are interested in the photography of rapid events, and the author is to be congratulated on having produced a very valuable contribution to the literature.

The author in his preface makes it clear that the book is not a textbook with practical instructions for the carrying out of actual work, but is a theoretical description of the general basis on which high-speed photography is founded and of the apparatus capable of undertaking the work in a very large number of fields.

The methods described include the taking of single pictures with high-speed flash equipment, and also spark and Schlieren photography, but it also includes high-speed motion picture cameras and film cameras of the drum type. The treatment of all these methods is very thorough and a very valuable proportion of the book is the bibliography which contains over 200 references to original papers.

The second part of the book deals with the application of high-speed photography to various fields of research, including physics and engineering, zoology, biology and medicine and military applications.

The book is excellently produced and the series of plates are of high quality and cover almost the entire range of methods described in the book.

R. McV. WESTON.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

R. H. CRICKS has been appointed a Director of Marsland Publications, Ltd.

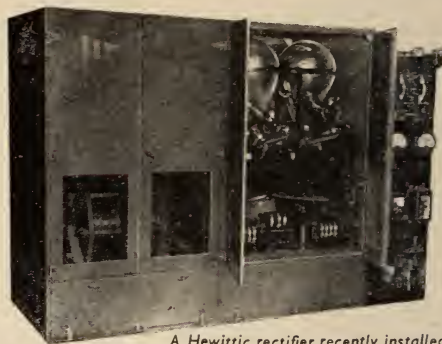
J. M. HARBITTLE has been appointed Assistant Technical Photographer to the Dunlop Technical Photographic Services.

PERSONAL ANNOUNCEMENT

Wanted, Photographic Lens Designer experienced in high quality photographic objective development and design. Permanent position. Attractive salary. Moving expense will be paid. Farrand Optical Co., Inc., 4401, Bronx Blvd., New York, 70, N.Y., U.S.A.

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A Hewittic rectifier recently installed for studio lighting. Output 1,000 amps., 115 V., D.C. Overload capacity: 25% for 2 hours. (100% momentarily.) Ripple voltage less than $\pm 1\%$.

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- Backed by over 40 years' experience in the manufacture of rectifiers. Used by more than 1,500 cinemas for projector arc supply.

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THE FELLOWSHIP

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The precise requirements for Fellowship are difficult to summarise in the space at my disposal, but an applicant must have attained eminence in the

industry or by research or invention materially advanced the science or art of cinematography. Alternatively, he must have delivered a thesis or lecture or presented a demonstration on the subject in which he has gained distinction or upon which he has conducted research, to the Council's satisfaction.

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I. D. WRATTEN, Hon. F.B.K.S., F.R.P.S.

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THE GEVACOLOR PROCESSES

H. Verkinderen*

Read by L. Meeussen to a meeting of the Film Production Division on April 25, 1951

THE Gevacolor negative/positive process can be classified as a subtractive colour process with multilayer materials.

The primary colours, red, green and blue, of the subject are registered as partial images in three separate light sensitive layers.

Each of these three light sensitive layers contains an appropriate colour-coupler which, due to its chemical structure, possesses the peculiar quality that it cannot bleed from one layer to another.

The development of both negative and positive material is carried out in baths containing diethyl paraphenylene diamine. This developer attacks the exposed silver haloid crystals, converts them to silver and thereby becomes a reaction-product which technicians call "oxidisation products." These "oxidisation products" of diethyl paraphenylene diamine react jointly with the colour-couplers to form the dyes. This silver, the oxidisation products and the dyes are formed in mutually proportional quantities, so that the three partial images will be reproduced in different colours in both negative and positive.

The choice of the absorption characteristics of the dyes which are formed in the course of the development is dependent on the sensitivity of the light reaching the film as illustrated by Fig. 1.

From this it will easily be observed that a red object is registered in the bottom layer in the shape of a cyan-coloured image.

During the printing process this cyan-coloured image absorbs red light and in consequence no cyan dye is formed in this particular layer of the positive, but, on the contrary, yields both a magenta and a yellow image, which when projected together form a red image.

This argument holds good for every colour and consequently the manner in which

coloured pictures are obtained through the Gevacolor negative/positive process can easily be followed.

Briefly, a developed Gevacolor negative or positive may be considered as a pack of three negatives or positives, which—although they are bound together—remain in principle independent the one from the other.

At first sight it therefore appears possible to apply the black-and-white technique without alteration for the Gevacolor process.

In several ways this is really the case, so that part of the equipment employed in black-and-white technique can be used unchanged provided alterations are carried out in one or two stages of the whole process. However, in certain cases it is desirable to make allowances for the multiple characteristics of both the negative and positive.

In the course of the present paper it will be explained to what extent black-and-white technique is applicable and, in case of deviation, the method recommended.

The following sequence of problems will be explained:

1. Exposure technique.
2. Development of the negative.
3. Grading and printing of the negative.
4. Development of the positive-sound track as well as image.
5. Methods of "Duplicating."

I. Exposure Technique

A monopack film such as the Gevacolor negative can be used in a standard camera. From this point of view no difficulties are experienced.

The use of coated lenses is to be recommended. Furthermore, objectives should be of the apochromat type and carefully corrected for the whole spectrum, but particular attention should be paid to the resolving power, that is to say, even more so than in the case of black-and-white. Indeed, a multi-

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layer negative possesses less resolving power than a black-and-white negative. The reason for this being that the red-sensitive and green-sensitive layers, which are of primary importance when judging the definition of an image, are covered by the blue-sensitive emulsion layer acting as a diffusing screen. Moreover, this diffusion is still further augmented by the distance—however slight it may be—separating the two bottom layers from the uppermost surface of the top layer.

No opportunity should be ignored to ensure good definition, and primarily this is

and-white and colour film will be encountered. Therefore, light intensities from 1,500 to 2,000 ft. candles would be required if it is desired to work with an aperture of $F/3.5$ to $F/4$ to obtain increased depth of focus, or 500 ft. candles at $F/2$.

Whereas for black-and white production lamps of an intensity of 500 watts to 1,000 watts are required, it is essential to employ lamps of 2 to 5 K.W. for colour film. If large scenes have to be lit, it will sometimes even prove necessary to add arc lights.

Therefore, before commencing the production of a colour film due allowance must be

Position of layers	Sensitive to	Colour	Colour of light absorbed
Top	Blue	Yellow	Blue
Middle	Green	Magenta	Green
Bottom	Red	Cyan	Red

Fig. 1. Sensitivity and colours of the various layers.

secured by using lenses possessing really high resolving power.

Speed of the Material

The speed of the material composing a colour-film lies notably below that of black-and-white films at present in use.

Allowance should be made for a speed of 16 A.S.A. in artificial light and from 10 to 12 A.S.A. in daylight (according to the filter used, of which details will be furnished later).

It will be obvious that the speed can still be forced up; but it is even then to be expected that black-and-white negatives will always be from four to six times faster than the colour-film negatives of the monopack type.

In the latter case each layer records a third of the spectrum only, whereas a black-and-white emulsion records the entire spectrum. Furthermore, one of the layers is screened by at least two others; it should be reckoned that in consequence only 50% of the penetrating light reaches the lowest layer.

Assuming all things are equal as regards both the emulsion and sensitising technique, a ratio of 6 to 1 between the speed of black-

made for the fact that the cost of lighting will be considerably higher than for black-and-white, both for hire of lighting equipment as well as for consumption of current.

On the other hand, some cameramen have commented that the time devoted to lighting for colour did not require more time than for black-and-white. It may be assumed that expenses for lighting will be three to four times higher when making a film on Gevacolor.

High Light Intensities

As relatively high light intensities are involved when filming in colour there is little risk of the negative being over-exposed. Over-exposure, however, is not detrimental to colour-rendition but reduces definition. Under-exposure, on the contrary, can adversely affect colour-rendition.

In consequence, it is advisable to measure light intensities carefully; the incident light method is preferable to reflected light measurement. The contrast range of a colour film is lower than that of a black-and-white film.

It is recommended that light intensity in

the shadows should not be reduced to less than one-third, or, better still, one-half of that prevailing in the high lights.

This limitation in light and shadow is not detrimental to colour film although it might be to black-and-white. The former relies as a means of expression upon colours and a true grey scale for picture construction, the latter simply upon the grey scale.

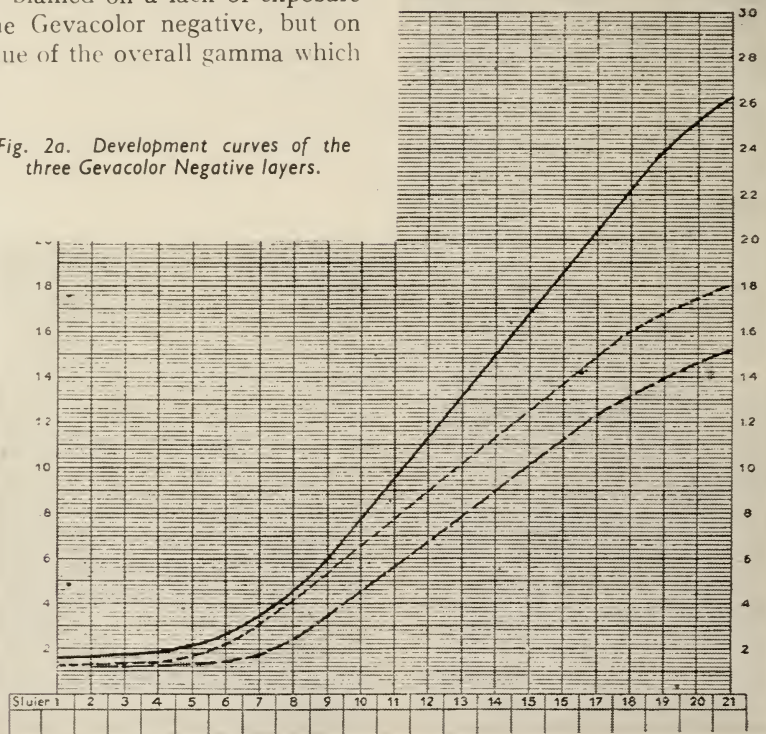
The reason for this limitation in contrast should not be blamed on a lack of exposure latitude of the Gevacolor negative, but on the higher value of the overall gamma which

The grey wedge portion of the sensitometer on colour film is much shorter, so that it is imperative, when shooting on colour film, that the lighting of the subject should be "flatter" than is the case for black-and-white.

Light Source

Lighting equipment normally used for black-and-white production comprises incan-

Fig. 2a. Development curves of the three Gevacolor Negative layers.



must be maintained to secure reasonable colour rendition. This subject will be referred to later.

In Fig. 2 it will be seen that the exposure latitude in the negative is more than sufficient, and in Fig. 3 that the slope of the positive curves conform to black-and-white procedure.

The curve in Fig. 4 illustrates how a sensitometric grey wedge appears on projection. The black-and-white record is very faithful. The slope of the colour film curve is only 30% greater, so that a reasonable part of the sensitometric wedge is able to be reproduced.

descent lamps, arc lights, daylight and even fluorescent lamps.

The type of light source to be used for colour film is a matter for consideration. For each type of light source there exists a well-defined ratio between the quantities of red, green and blue light emitted.

Gevacolor negative contains, as already stated, three light-sensitive layers, each of which is sensitive to one of each of the three colours mentioned.

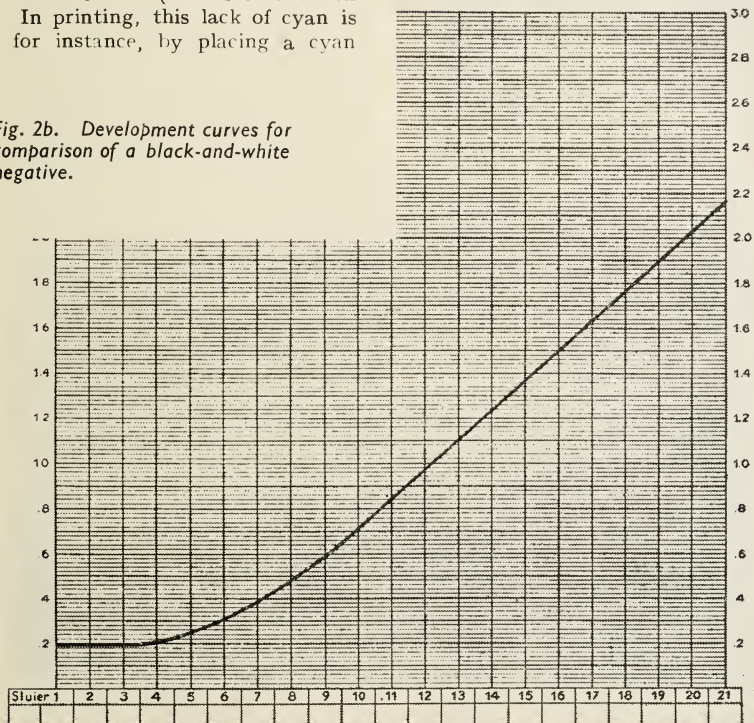
It is quite obvious that the speed of the three emulsion layers must be mutually and inversely proportional to the above indicated

ratio, so that the three layers will record equally and reproduce varying shades of grey. But this is an ideal example.

Now let us examine the results if these conditions are not complied with. In Fig. 5, if one of the layers, say the red sensitive one, is not fast enough, then:

1. Certain dark grey hues will be recorded in the two top layers, but not in the third one;
2. the negative will contain less dye in the layer which is too slow (in this case a lack of cyan). In printing, this lack of cyan is rectified, for instance, by placing a cyan

Fig. 2b. Development curves for comparison of a black-and-white negative.



filter in the light beam of the printer in order to re-create the grey scale.

On the other hand, where there is insufficient cyan record in the print there will be too much cyan in the negative, with the result that the print will have an excess of its complementary colour, *i.e.* red.

In order to avoid distortion or degradation of colours it is essential, therefore, that exposures should be made in such a manner that the slowest layer is well exposed, the two other layers being over-exposed, which, however, results in:

1. A proportional loss in definition;

2. difficulties in printing (stronger filters with consequent loss of light and/or reduction of printer speed).

From the foregoing explanation it is apparent that for each type of light source either a different type of colour negative film would have to be manufactured, or that methods would have to be devised to balance the composition of the light sources to suit the sensitivity of the negative. The latter suggestion

means that one type of negative can be used with different types of light sources. For Gevacolor negative the sensitivity balance of the three emulsion layers has been adjusted for studio incandescent lamps. Daylight or arc lamps also can be used provided a filter is placed somewhere between the light source and the film to absorb the surplus quantities of blue and green light.

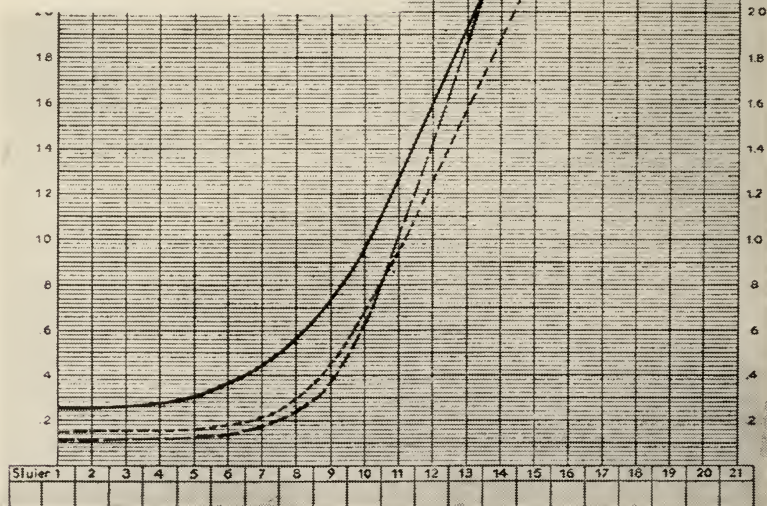
The usual practice is to use a conversion filter on the front of the lens. However, when using incandescent lamps and arc lamps at the same time, correction filters must be placed over the arc lamps.

It is obvious that if no special effects are required and that sufficient lamps of the same colour value are available, only lamps of one and the same light composition should be utilised.

Some further important points to note are:

1. That it has been established that the colour balance of Gevacolor negative changes when the exposure time is not normal. For instance, for exposures of about one second this alteration in balance can be compensated by using a C.T.0.8 filter in artificial light.

Fig. 3a. Development Curves of the three Gevacolor Positive layers.



2. The night effects are just as for black-and-white. Under-expose slightly and choose the maximum permissible light contrast of 1 to 3. If a difference in tone between highlights and shadows is desired, this effect can be obtained by lighting the shadows and the highlights with light of different composition, or else by shooting through a filter the colour of which is complementary to the tone desired in the shadows.

For example, an orange filter (say C.T.0.8) reduces the speed of the blue sensitive layer and, to a lesser degree, that of the green sensitive layer. The negative turns blue and in the print shadows, as explained

earlier, will then also appear on the bluish side.

3. Polarisation filters can be employed either to dim undesirable reflections or to modify the contrast of clouds versus blue sky. (Direction of polarisation should be perpendicular to direction of the sun.)

4. There is no objection whatever to the

use of graduated filters provided they are grey.

It is impossible to exhaust the possibilities of exposure technique. Every day camera-men will be confronted with new problems, yet it is hoped that the various comments made in the present paper may have contributed in some slight manner to a satisfactory solution to some of the difficulties.

2. Development of the Negative

Gevacolor negative film can be processed in machines of the standard type.

It is obvious that the composition and

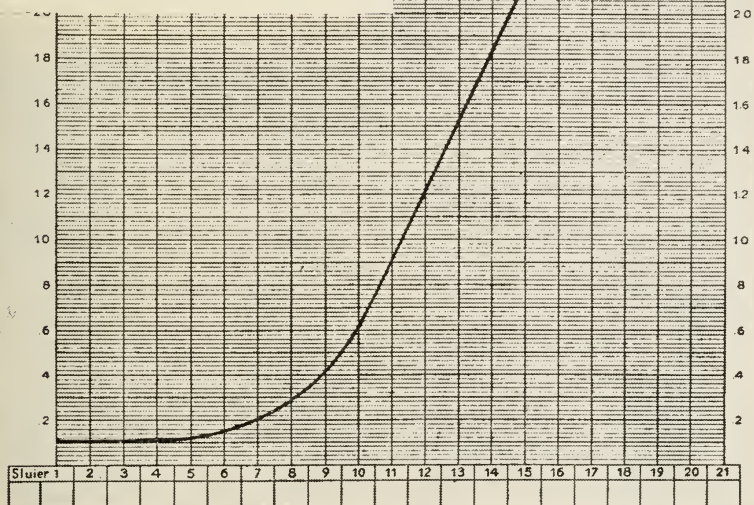
sequence of the baths is not the same as for black-and-white.

Details of the formulae, etc., are available, but it would take too much time to include them in this paper.

However, three points could perhaps be stressed:

1. Extreme agitation in the developer is recommended in order to ensure consistent development.
2. Rinsing should be carried out thoroughly, preferably by spray.
3. The sensitivity of the negative is to a great

Fig. 3b. Development curves for comparison of a black-and-white fine grain positive.



extent influenced by the potassium bromide content in the developer and this content has a tendency to increase since development causes the formation of still further bromide.

In order to maintain this potassium bromide content at its proper value it is essential to replenish regularly with a bath excluding potassium bromide.

3. Grading and Printing of the Negatives

The finished Gevacolor negative can be copied on to Gevacolor positive on printing machines complying with the following stipulations:

1. They should be equipped with an optical system giving a light beam which is as near

parallel as possible. Printing with such light gives sharper images than with diffused light.

2. They should be fitted with some device for adjusting the printer light by means of apertures and filters.

As a matter of fact, the cyan and magenta layers in both the Gevacolor negative and positive, which contribute to a large extent

to the sharpness, do not lie near the surface of the film.

Loss of Definition

During contact printing, due to the various layers of the positive being separated from those of the negative the print is certain to lose definition if diffused light is used. With parallel printing light the loss in sharpness is almost insignificant.

The intensity of the printer light is controlled most conveniently by inserting apertures of appropriate diameters changing the density of the three layers simultaneously and to the same extent. Filters to balance the colour of each separate layer are added over

the various apertures. Variation of the printing light by voltage control must be avoided, as the relative values of blue, green and red light are thereby altered.

Speed of Positive Layers

The grading of prints is far more complicated for colour film than for black-and-white negatives because each one of the partial images in the three layers of the

"test strips" from every scene using different combinations of filters for successive pairs of frames.

From an examination of these test strips the test filter combination could be selected to give a correct grey balance.

Another method consists of compiling a "short" test (two frames from the beginning and end of each scene); by a series of tests it is possible with a minimum consumption of positive stock to determine the data required to make a correct copy.

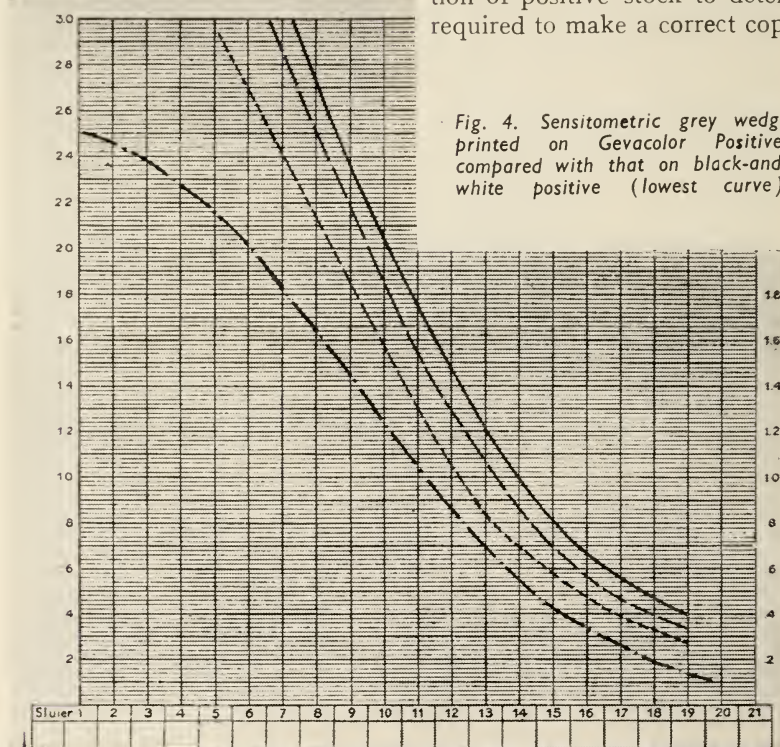


Fig. 4. Sensitometric grey wedge printed on Gevacolor Positive, compared with that on black-and-white positive (lowest curve).

finished colour negative must be considered as separate negatives; for each of these negatives the correct printing light has to be selected in such a manner that a positive is obtained possessing a perfect grey balance. Furthermore, the relative speed of the three positive layers may differ slightly from batch to batch.

The solution to this problem is dependent on a trial and error method, as no known method after examination of a first print has been discovered to determine the exact correction that should be applied.

Of course, it is possible to print so-called

In order to compensate for variations between positive batches, a filter—selected for each batch—can be located permanently in the optical system to balance the relative speeds of the different layers to that of a predetermined reference standard.

Another method consists in finding a filter for each positive batch which, for the printing machine to be used and under the circumstances in which the work will be carried out, will give a print as neutral as possible from a black-and-white negative.

By the use of these correction filters for various batches, any negative can be printed

on different positive batches with the same previously selected filter band without further alteration.

4. Development of the Positive

Positive stock is processed in machines of standard construction. The composition and sequence of baths is given in the directions issued for Gevacolor positive. Previous comments on negative development as to turbulence and spray washing are also applicable to positive processing.

The Bleaching Bath

The essential difference between processing Gevacolor negative and positive with sound track is in the bleaching bath. Bleach-

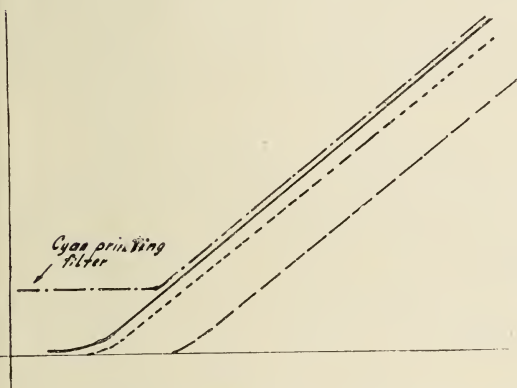


Fig. 5. By using the appropriate cyan filter—the yellow and green layers are reduced in speed to match the blue-green layer.

ing of negative film is carried out over its entire width, whereas bleaching of positive film is done in the image parts only, so that it leaves the silver in the sound track.

In order to maintain maximum resolution the sound track must be formed in the top layer (using a blue filter on the printing machine) and is, after development and fixing, formed of silver and yellow dye. The yellow dye is of no consequence.

The sensitivity range of photo-cells in projectors considerably exceeds the visible spectrum (ranging from blue to infra-red).

The absorption of the yellow dye in the sound track is equivalent to a silver density of 0.1. Therefore, in order to arrive at an acceptable sound value it is essential that the

silver which has been formed during development of the sound track is not bleached.

Experiments have proved that the density of the sound track, *i.e.* silver + dye, is below that of black-and-white, and it has appeared necessary upon projection to adjust the fader to a higher level for colour film than for black-and-white.

Viscous Bleaching Paste

As described in the working instructions for Gevacolor positive, the image parts of the positive are bleached out by means of a viscous bleaching paste. The coating is done through an applicator provided with a slit 1 mm. wide through which the paste is extruded. The slit is connected to a tank kept at constant temperature and fitted on a somewhat higher level.

The viscosity of the paste should be maintained at about 1,000 centipoise (units of viscosity), while the tank should be fixed up at such a level that the quantity of paste passing through the slit always slightly exceeds that taken up by the film. The normal thickness of the paste layer is about $\frac{1}{2}$ mm. of $\frac{1}{50}$ th of an inch.

By accelerating the speed of the film a thicker layer of paste will be picked up; to counteract this the viscosity should be decreased. In order to curtail spreading of the paste from both sides of the image zone, two small balancing knives should be fitted to the right and left sides of the coating slit and which would continually glide over the film surface. The coating slit should also be provided with a small gutter to collect the surplus paste.

After completion of the bleaching process the paste is scraped off by means of a "squeegee" composed of rubber lips placed in a slanting position lengthwise of the film.

Bleaching by means of viscous paste is already practised on a large scale in more than one laboratory, and has been used on at least five feature films. This method, which at first sight seems difficult, is quite easy if the job is done carefully.

The greatest difficulty consists in obtaining a homogeneous paste, free of lumps. In this

connection special care should be devoted to the raw material.

In view of the fact that potassium ferricyanide attacks nearly all metals, it is advisable to build the apparatus, if possible, of plastic material. Furthermore, it is recommended that, to avoid distortion, sound negatives to be copied should be recorded on a variable area system. The original sound recording can, of course, be carried out on any system.

5. Methods of "Duplicating"

The next point of interest in the Gevacolor process is that of duplicating. The reason why the normal black-and-white technique cannot be applied for Gevacolor negatives is that each colour printing step results in a loss of saturation and a third generation print will be unacceptable. To avoid this loss in satu-

ration the number of colour printing steps should be kept as low as possible. Three methods are possible to obtain a dupe from the original negative:

1. Printing the original on a duplicating reversal material. The final print is then a second generation copy. An optical printer must be used to obtain the final image in its normal position. The only drawback of this method is that the processing is longer and not so reliable.

2. Three positive extracts can be made from the original negative. Black-and-white duplicate negatives of these three positive extracts can be printed in sequence in register on to a Gevacolor Positive. The number of colour printing steps are reduced to a minimum (one), but, on the other hand, as every final copy has to run three times through the printer, the process will be un-

TABLE OF COLOUR CORRECTION FILTERS—(Gevacolor Negatives)

Lighting of subject	Colour Temperature	Filter	Filter factor (lens stops)
Studio Incandescents	2800—2900	—	—
Projection lamps or Photofloods (100-hour life)	3200	—	—
Photofloods (2-hour life)	3400	—	—
Sunlight — 1 or 2 hours before sunset or after sunrise	5000	CTO 12	+ 1/2
Sunlight and blue sky	6000	CTO 16	+ 3/4
Shadow — 1 or 2 hours after sunrise or before sunset	6000	CTO 16	+ 3/4
Overcast sky	6800	CTO 20	+ 3/4
Shadow, but blue sky	8000—9000	CTO 20	+ 3/4
Arc lamp	5500	CTO 12	+ 1/2

economical unless special printers are devised on which the printing of the three negatives can be done in one operation.

3. A third method is to print the original negative on:

- (a) a red sensitive black-and-white positive through a deep red filter (Gevaert R.678);
- (b) a green sensitive black-and-white positive through a dense yellow filter (Gevaert G.5);
- (c) a non-sensitised black-and-white positive through a blue filter (Gevaert B.479).

These duplicating positives can be processed in a normal developer such as the Gevaert 206 or the D.76, to a gamma of about 1.2-1.3.

These three positive extracts are then printed in register on to a Gevacolor duplicating negative as follows:

- (a) the red sensitive positive (red extract) through a red filter (Gevaert R.619);
- (b) the green sensitive (green extract) through a green filter (Gevaert G.537);
- (c) the non sensitised positive (blue extract) through a blue filter (Gevaert B.479).

This duplicating negative must then be processed exactly as for Gevacolor negative. The time of development is 6 minutes at 18° C (65° F).

This third method avoids the difficulties of processing of the first method and the printing difficulties of the second one.

The third method has been used in some feature films, with reasonable results, for making "mixes" and "fades."

Defects in Absorption Spectrum

As stated, each colour printing step means a loss of saturation. This loss in quality is due to the fact that the cyan and magenta dyes are absorbing light not only in the region of the spectrum where they should absorb but also in the other regions. These defects in the absorption spectrum of the cyan and magenta dyes introduce in the negative a certain amount of grey. This amount of grey is printed on to the positive. This grey content is still further increased by the grey introduced by the cyan and magenta images of the positive itself. On the other

hand, these losses in saturation are counteracted by two different effects. There is a different effect on our eyes firstly by looking at a screen or secondly at the subject itself.

In the first case, the saturation of colours is enhanced by the contrast due to the rather dark surroundings of the screen. In the second case of normal vision the apparent colour saturation is reduced by the surroundings illuminated as brightly as the subject.

Another effect is a photographic one, which can best be explained by the following example:

Expose in a sensitometer three negative strips through a red, a green and a blue filter. Let us call them: red, green and blue strips. Expose a fourth strip in the same sensitometer to red, green and blue light successively. Call this the grey strip. Let us process the four strips. At a first glance the pack formed by superimposition of the three "single exposure" strips is identical to the grey strip. In practice, however, the composite wedge strip formed by the three superimposed strips will be of a higher contrast than that of the "grey strip."

Measurements on an equivalent densitometer show that the contrast of a wedge exposed in only one layer of a Gevacolor material is higher than that of the same layer when the two other layers are also exposed.

This phenomenon is due to the higher exhaustion of the developer where three layers are to be developed than if only one layer is attacked. As a result the saturation in negative and positive is higher than can be expected on account of the absorption spectra of the dyes.

The combined action of the desaturation in duplicating due to absorption defects of the dyes and the increase in saturation due to the projection of the positive in dark surroundings, added to the last effect described, result in an acceptable print.

With this knowledge the saturation can still be increased within reasonable limits by increasing the overall gamma of the process.

THE ECONOMICS OF FILM PRODUCTION

C. Vinten (Member)*

Summary of paper read to the Film Production Division on March 21, 1951.

I WOULD like in this paper to enquire into the relationships that exist between studio equipment, studios, technicians, and the film producers who should bind all three of these together.

The most expensive item facing the producer is time—and it is the manufacturer's duty to provide the equipment which will enable the producer to go ahead with all possible speed, recording the results of his creative ability with the minimum of technical restrictions or limitations.

I am aware that a good deal has been done by planning scripts more thoroughly, by "visuals," the use of independent frame, etc. This is the organisational part of picture making. On the technical side all possible means of speeding up shooting must be found, and to help achieve this the producer and director must see the results of their work at the earliest possible moment. For example, just as there is now the facility of playing back the sound on magnetic film, so there should be a means of playing back the picture. By the full utilisation of all modern technical aids it should be possible on many subjects to achieve an output of as much as twenty minutes a day, as compared with the present average of from three to four minutes.

This may be regarded as a criticism of the director and the art director, but it is certainly not intended as such. The gaps and weaknesses are largely the direct result of the use of redundant equipment and methods in the majority of our studios. Directors are required to make a first-class film which will produce a profit, and they have to use clapper-boards, tape measures, chalk marks on the floor and megaphones. Except for magnetic film, equipment in use in many British studios is mostly twenty years old in design. Such primitive tools may mean heavy labour costs, slow work and bad continuity. All are replaceable: the clapper-

boards by silent turnover, the tape measures and chalk marks on the floor by range finders coupled to the camera lens focusing, and the megaphones could easily be replaced by a telephone system with acoustic micro-



Fig. 1. Vinten Pathfinder camera crane.

phone for the director and earphones for the camera crew.

The question of playing back the picture immediately can be solved by the use of a television unit coupled to the picture and by the use of magnetic film. In any case much of the responsibility would be taken from the director whilst he is on the floor by the art director viewing the take on a television screen in the viewing theatre during the actual shooting. He would thus take over the responsibility of maintaining the atmosphere of the film, leaving the director on the floor

* W. Vinten, Ltd.

to control the artists' movements, etc. This television service would also be of use to continuity and other studio personnel.

Studio Lamps

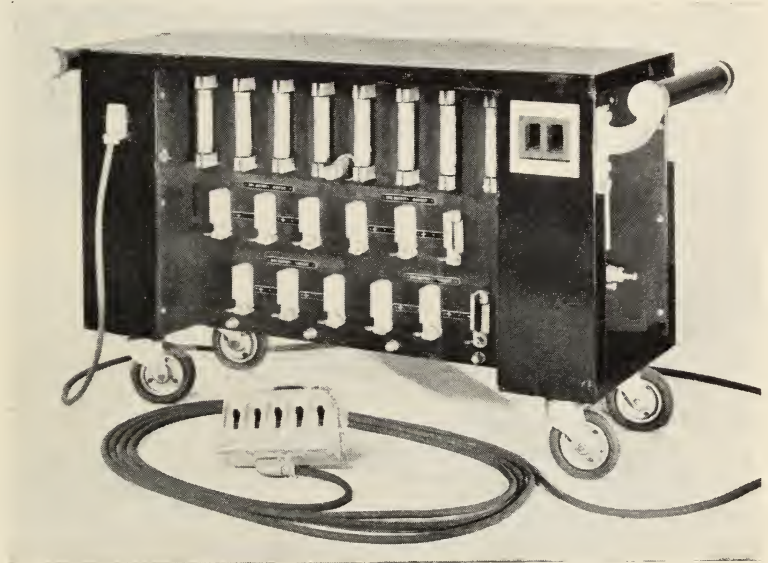
One of the most time-wasting and irritating jobs on the studio floor is the setting of the studio lamps. It would seem that the usual screw-lock and primitive swivel on studio lamps is long overdue for replacement by motor drive. I cannot see why a small motor and worm gear reduction should not be fitted to both the tilt and panning move-

shutters, double negative carbon arcs and other developments, all of which are now slowly finding their way into the studios.

Camera Dollies

I am pleased to be able to tell you that power-operated camera dollies will shortly be in use. I do not expect the film industry to take kindly to these novelties, but in this case television will be showing them the way. These trucks can eventually be fitted with an automatic control so that if the action was correct on rehearsal, the truck will repeat

Fig. 2. Mole-Richardson remote control truck.



ment, so that by means of drop strings on the studio floor the lamps could be set without the usual trouble. If drop strings are not practicable for this purpose, possibly four photo-cells of the direct shorting type could be employed, heavily hooded and pointing down at the floor. In this way the camera lighting assistant could shine a torch at the appropriate photo-cell, start up the motor, and retrain the lamp in the right direction.

I feel it can be said that on the majority of studio floors in this country far more time is spent setting lamps than is actually spent shooting films. Thought has, of course, been given by Dr. F. S. Hawkins and Mr. C. G. Heys-Hallett to the remote control of lamps, series connected arcs, remote control lamp

exactly the same movements as many times as they are required. This development is essential for television plays and productions, and I have no doubt that in due course the power-operated camera dolly or miniature camera crane, as now used by the B.B.C., will find its way into film studios.

Equipment Maintenance

A further very heavy expense to British studios at the present time is the maintenance of old American equipment. This is due mainly to the fact that there are very few dollars for spare parts maintenance.

Equipment of the ancient type has a very bad record as far as retarding the production of films in this country is concerned. The cost of a completely new camera or recording apparatus can be lost over one or two pro-

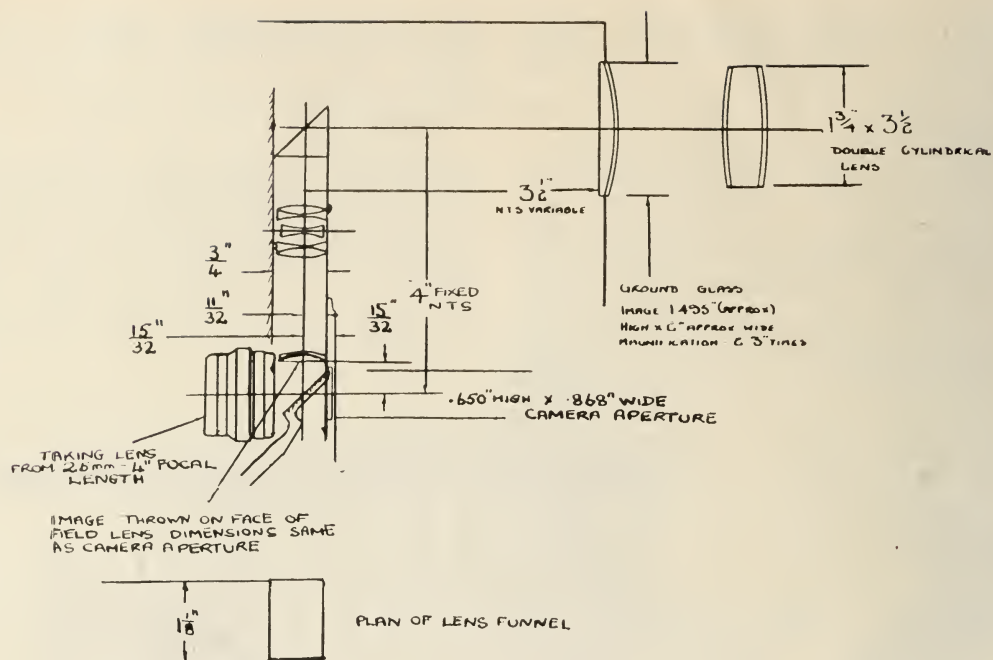


Fig. 3. Mirror shutter optical arrangement of Vinten Everest camera.

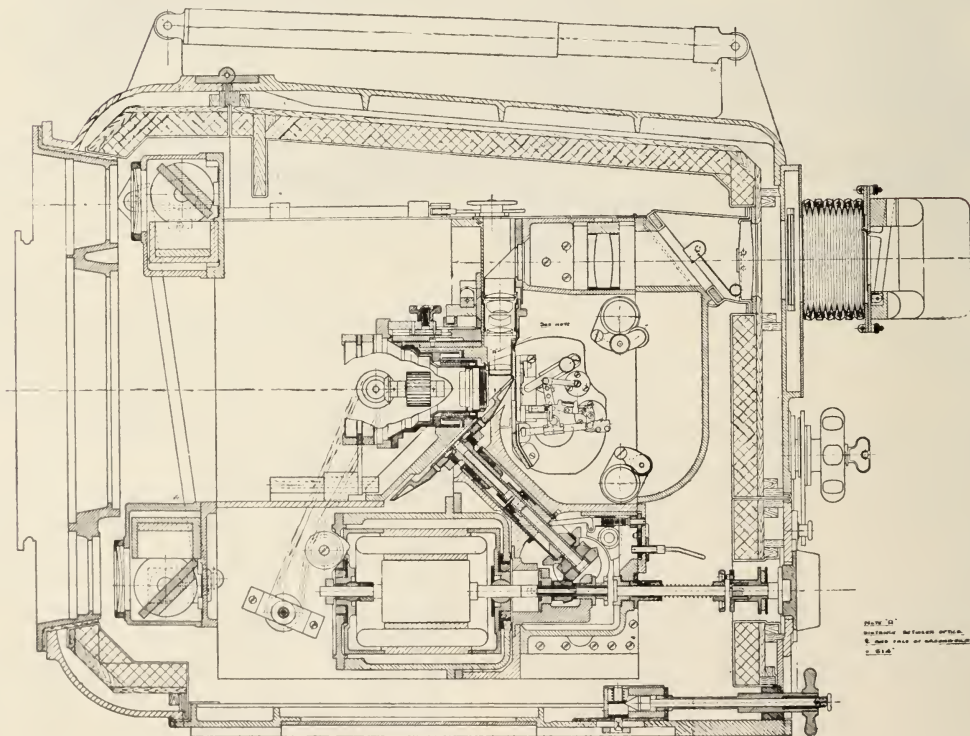


Fig. 4. Everest II camera. Section through optical centre line.

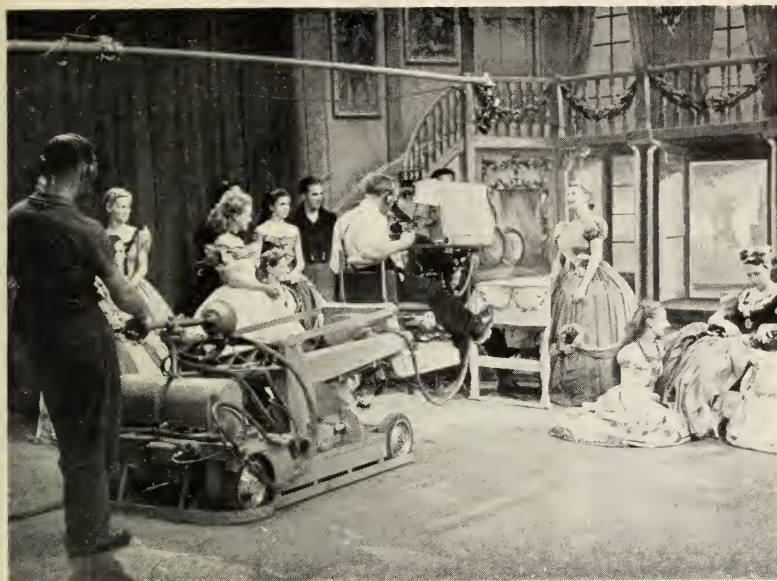


Fig. 5. Vinten miniature camera crane in use for a TV production.
(By courtesy of the B.B.C.)

ductions because of holdups due to lack of correct spare parts and manufacturers' services for equipment maintenance. Foreign cameras, built for use in a different climate than ours, are apt to give an enormous amount of trouble, for they become out of synchronisation when subjected to cold and damp conditions on exterior locations. It is a habit in this country to use the same camera whenever possible for location and studio work. There has been a tendency when the studio camera is taken out on loca-

tion to leave the blimp behind. I deplore this, as, apart from indicating a certain amount of laziness, it assumes that the acoustic conditions outside are completely different from those in the studio. In actual fact, when local noises, such as aeroplanes, traffic or high winds, permit, acoustic conditions are generally ideal for recording—and by endeavouring to obtain as much sound as possible, expensive post-synchronising is avoided. Steps should be taken to sound-proof the lighting generator, if it is used.

Camera equipment built and designed for this climate should have plenty of power margin on its synchronous motor for driving the camera under cold conditions, and should be combined with an electrical heater, where current is available, so that under extreme conditions the inside of the blimp can be kept warm.

These are some of the main technical facilities which will speed up production. If I have blamed the studio managements for not being progressive enough, I also realise that they are restricted in capital expenditure, especially at the present moment. Nevertheless, the equipment is available—and they should give the matter very serious thought.

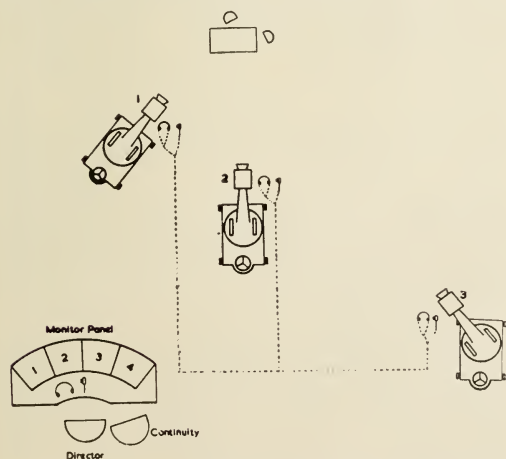


Fig. 6. Suggested plan for television monitoring system.

PRACTICAL SOLUTION TO THE SCREEN LIGHT DISTRIBUTION PROBLEM

Charles R. Underhill, Jr.*

*Read to a meeting of the Society of Motion Picture and Television Engineers on May 2, 1951.
Reprinted from the Journal of the S.M.P. & T.E., Vol. 56, No. 6, June, 1951.*

IT is a well-known fact that the side-to-centre distribution of light on the common uniformly perforated, or unperforated, sound motion picture screen, when illuminated by the modern carbon-arc lamp, is limited to about 80%¹ under the most favourable conditions of projection equipment adjustments. In actual practice the brightness in the side portions as compared with the brightness in the centre of the screen is often much less.

In a specific instance,² measurements on a screen 25 ft. wide showed a brightness of 9.6 ft.-L at the centre of the screen, 9.2 ft.-L at a point 4 ft. from the centre, 8.1 ft.-L at a point 8 ft. from the centre, and 6.2 ft.-L at a point 12 ft. from the centre. The brightness in the side portions as compared with the brightness in the centre was 64.5%. This is believed to represent about the average of the ratios which exist in motion picture theatres to-day.

The various causes of uneven distribution of light on the screen and other light source problems are generally known and have been published in the S.M.P. & T.E. Journal and elsewhere.³⁻⁹ They become manifest as observable results seen on a screen surface, beyond which the screen is not otherwise involved.

The screen which appreciably compensates for the uneven illumination from the light projected upon it is known as the Snowwhite Evenlite† perforated sound motion picture screen. Its design is based on a patented perforating technique which compensates for and, at least partially, counteracts the difference between the illumination at the centre

of the screen and the side portions. Maximum perforation of 8% of total area at the centre of the screen is employed where the illumination is brightest, and where the speakers behind the screen are commonly located. This portion of the screen's total area is equivalent to the common uniformly perforated screen, and has 42 perforations per square inch, each perforation being 0.050 in. in diameter. Screens made entirely of this uniform perforated material have consistently been shown by test to have less high-frequency attenuation than the losses permissible for an efficient sound screen according to S.M.P.T.E. recommendations. As a matter of fact, this uniform perforation pattern is commonly used by several screen manufacturers.

However, on the side portions of the Snowwhite Evenlite screen where the illumination is lowest there are no perforations. Between the centre portion and each side portion of the screen is a gradational perforation area in which the perforations per square inch in a transverse direction decrease in number, as well as in diameter, until they are eliminated entirely. Thus there is a gradual transition from centre to side portions from a perforated to an unperforated surface, and the change is made sufficiently gradual to be entirely imperceptible to the eye in the reflected light. At the same time, because the light reflection is reduced at the centre of the screen where the illumination is highest, the brightness appears even over all portions of the screen surface.

The Snowwhite Evenlite screen is constructed of vertical panels of screen material. A screen 25 ft. wide, for instance, requires a total of seven panels to make up the full

† Manufactured for and distributed by RCA.

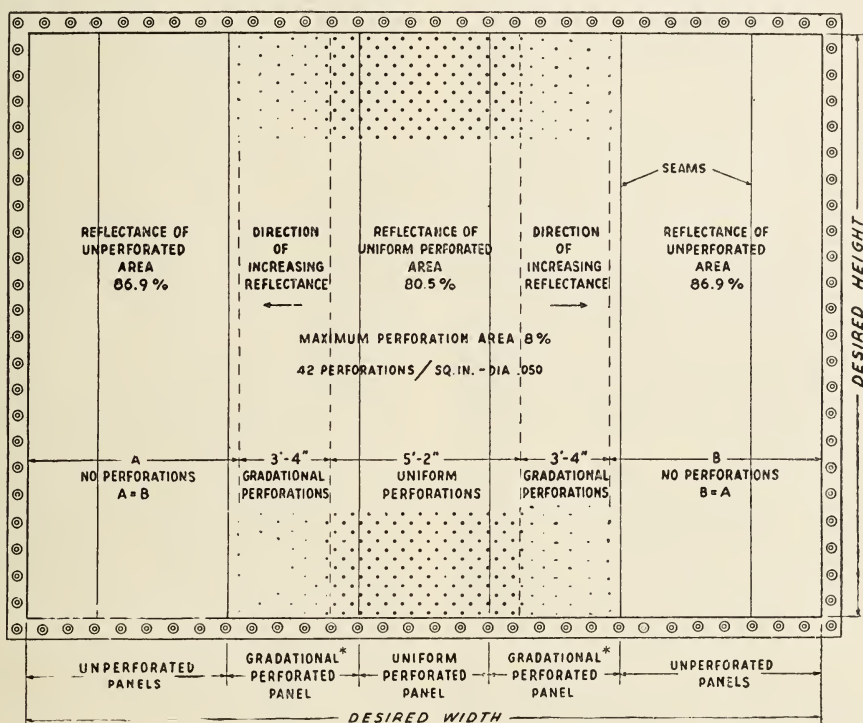
* Engineering Products Dept., RCA Victor Division, Camden, N.J., U.S.A.

25 ft. width of the screen, all, of course, of the same screen material but of three types, either uniformly perforated, gradationally perforated or unperforated, sewn together in proper arrangement to meet design specifications. The gradationally perforated panels actually include uniform perforations along a 6 in. width on one side of the panel for matching with the centre panel. There is also a 4 in. width on the opposite side of the panel, having no perforations for matching

comprise equal panels of required widths to complete the full screen dimensions.

As the width of the combined uniform and gradational areas is always 142 in., the larger the screen dimensions, the greater will be the unperforated area.

The particular screen referred to, having a width of 25 ft., actually has an unperforated area 52.7% of the total area, and the uniformly perforated area is only 20.7% of the total area. The gradational area is



with the unperforated outer portions of the screen.

Thus the area of each of the two gradationally perforated portions in any screen is only 40 in. times the screen height. The uniformly perforated centre area consists of the one 50 in. wide panel plus the two 6 in. widths in the matching areas of the gradational panels, times the screen height. Each unperforated area is always equal to one-half the screen width less 71 in., all times the screen height. These unperforated portions

26.6%. For a picture size of 29 ft. 9 in. by 41 ft., the unperforated area would be 71% of the total area.

Electrical Testing Laboratories have reported the reflectance of the uniformly perforated material used for the centre panel of the Snowwhite Evenlite screen to be 80.5%. Since the perforation area is 8%, a loss in light passing through these perforations is limited to 8%; therefore, the unperforated area of the same screen material has a reflectance 8% higher, or 86.9%. This is

believed to be the highest reflectance yet obtained from a white matte sound motion-picture screen. But the main point is that the reflectance of this screen varies by design between the limits of 80.5% and 86.9% in such a manner that, were the illumination of this screen uniform over the entire area, the brightness in the side portions would be 8% higher than at the centre.

No attempt has been made for gradational perforations in this screen in a vertical direction, partly because of manufacturing considerations, but principally because such a refinement would be negligible in the apparent uniform brightness of the picture image. This fact is illustrated by the brightness measurements previously given for the screen 25 ft. wide. The height of this screen is 18 ft. 3 in. One half the height is 9 ft. 1½ in. The brightness at a point 8 ft. from the centre was 8.1 ft.-L as compared to a brightness of 9.6 ft.-L at the centre. It is evident from this data that the distribution of light intensity at a point approximately one foot from the top or bottom edge of the picture area was actually 84.2% of the intensity at the centre, whereas at the sides of the screen the distribution was only 64.5%.

There is another factor which minimises the effect of the ratio of top or bottom edge-to-centre light. In the ordinary installation the projection when viewed in elevation is at an angle to the entire screen, and the viewing angle from an optimum seating area is less at the bottom of the screen than at the top. Therefore the difference in angularity and the consequent difference in illumination between the top and bottom of the screen is less noticeable than from the centre to side portions. The problem, of course, is to obtain as good a corner-to-centre light ratio as pos-

sible. The Evenlite screen, having no perforations in the corners or sides, and a maximum permissible perforation area in the centre, effectively accomplishes a practical solution to the problem.

The Snowwhite Evenlite screen, installed in any theatre, serves as a practical illustration of the fact that screens having properly designed perforation patterns and used under recommended viewing conditions have no detrimental effect whatsoever on the quality of the reflected picture. Here on a single screen surface a direct comparison can readily be made of the definition of the picture image reflected from the perforated and unperforated areas of the screen.

Though this paper is intended primarily to offer a practical solution to the screen illumination problem, the results of other tests made by Electrical Testing Laboratories are of interest when compared with A.S.A. specifications (American War Standards Z52.45—1945 and Z52.46—1945), verifying that no sacrifices in desirable characteristics have been necessary or have been made in the development of this screen. The whiteness ratio is 92½%. Brightness at 1.5° angle of observation of the uniform perforated material is 87.5%, with a gradual dropping off to only 78% at 60° angle observation. These tests, together with the exceptionally high reflectance and sound transmission characteristics previously referred to, combine in one screen all of the desirable qualities of both a uniformly perforated and an unperforated sound screen. What is most important, however, is that the Snowwhite Evenlite screen, in appreciably compensating for uneven illumination, does a better job as a sound motion picture screen than is possible with other types of screens.

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6. *J. Soc. Mot. Pic. Eng.*, 14, No. 3, March, 1930, p. 291.
7. *Trans. Soc. Mot. Pic. Eng.*, No. 11, Oct., 1920, p. 74.
8. *J. Soc. Mot. Pic. Eng.*, 23, No. 6, Dec., 1934, p. 309.
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STANDARDIZATION OF PROJECTION LAMPS

B. M. Furness (Associate)*

A SERIOUS effort is now being made by the Society of Motion Picture and Television Engineers to compile standards for two types of projection lamps for use in 16 mm. and 8 mm. kinematograph projection apparatus. Three separate lamps have been considered, two for use in the cap-down position and one cap-up. The first two lamps can be compared directly with those shown in B.S. 1522:1949, under refer-

ence numbers A1/7 and A1/9, but the other lamp is fitted with a cap of new design which does not seem to be interchangeable with any used in British or Continental apparatus. It is interesting to see how the proposed American dimensions and tolerance compare with British standards and standard practice. It should be noted that only dimensional details are under discussion.

Table I
CAP-UP BURNING LAMP

DIMENSION	PROPOSED AMERICAN STANDARD	EXISTING BRITISH EQUIVALENT*
Diameter	39 max	38 + 1
Overall length	149 max	141 ± 7
Light centre length	89 ± 0.5	89 ± 0.5
Axiality of filament with respect to cap	0.75	0.5
Concentricity of filament and bulb ...	a 2. (o) 0.9	1.5 in all directions
Tolerance on ring to contact distance	± 2.0	± 1.5
Angular relation of contacts to ring	90 ± 15	Not applicable
Angular relation of filament to ring axis	Parallel	90°

Table II
CAP-DOWN BURNING LAMP

Diameter	33 max	39 max	32 ± 1	38 ± 1
Overall length	14 max			
Light centre length	55.5 ± 0.75		55.5 ± 0.5	
Axiality of filament with respect to cap	0.75		0.5	
Concentricity of filament and bulb ...	(a) 2.4 (b) 0.9	(a) 2.6 (b) 0.9	1.5 in all directions	

(a) Towards Mirror (b) Towards Condenser

* Lamp fitted with S26s B.H., nearest British-made cap with which proposed new American cap can be compared.
* General Electric Company, Limited.

The specification shows that British lamp manufacturers are working to a much closer tolerance than American with respect to such dimensions as light centre length and axiality. The accuracy is, in fact, a third greater in the case of British-made lamps. Although there is a small discrepancy between the overall length of the cap-down burning lamps, it is doubtful whether in apparatus at present on the market the greater length of the American lamp is likely to cause embarrassment in more than a few isolated cases, if any.

The chief item that invites comment is the proposed use of a new design of prefocus cap for the lamp to be used in a cap-up position. There are in existence four well-known varieties of cap at which no criticism has been levelled to our knowledge. While the 3 pin

bayonet (B22/25 × 26 3 pin) and special Pathéscope (E27/35 × 30 long lug) caps are obsolete in as much as they are not employed by any manufacturer in current production, the other two are very much alive. The 3 pin cap has been adopted for the Debie and the new type of Bell and Howell (S.26 B.H.) has recently taken root outside America. We are somewhat dubious about the claims put forward that the new cap provides better cooling, filament positioning and easier replacement, and feel that any advantages that it may have will be outweighed by its being a new arrival of different size and shape from its brethren.

Specifications P.H. 22, 84 and P.H. 22, 85, as they are known, have not yet been approved and comments are invited.

REFERENCE

J. Soc. Mot. Pic. & Tel. Eng., 56, Feb., 1951, p. 236.

BOOK REVIEW

Books reviewed may be seen in the Society's Library.

Acoustic Measurements, by Leo L. Beranek, S.D., D.Sc. (Hons.). John Wiley & Sons Inc. (New York), Chapman & Hall (London), 914 pp. 8" × 5½", 56s.

This book, written in a clear, lucid style and well supported by drawings and diagrams, deals in considerable detail with the theory and technique of acoustic measurements. The author opens with a general survey of the theory of the propagation of sound waves and their disturbance by obstacles and finite baffles. Following the classical work of Raleigh and Schottky, he supports the reciprocity technique of calibration, from which he proceeds to discuss the principles and relative merits of the basic types of electro-acoustic devices for the measurement of sound pressures, particle velocities and leads to a detailed description of the indicating and integrating instruments for the measurement of complex sound waves. The author finally deals with methods of conducting articulation tests, the determination of the absorption characteristics of materials and the measurement of the acoustic properties of enclosed rooms, auditoria and studios.

The book should have an appeal to those engaged in the practical work of sound recording and reproduction as much as to research and laboratory workers.

L. KNOPP.

ROBERT ALFRED ALLMAN (Member)

Died August 15, 1951

A man of kindly disposition and a staunch friend to the many who knew him, was the tribute paid Robert Alfred Allman, Chief Engineer for Warner Bros. First National Productions, Ltd., at Teddington Studios, by G. L. Blattner, M.B.K.S., Studio Manager and Director.

The late R. A. Allman had been a member of the British Kinematograph Society since 1947, and his untimely death at Bognor, which occurred whilst he was recuperating from an illness, came as a profound shock to all who knew him.

AGFACOLOR BIBLIOGRAPHY

A comprehensive bibliography of the Agfacolor process has been compiled by Mr. Alexis N. Vorontzoff. The bibliography gives references to 236 articles and publications, and copies may be obtained from Mr. Vorontzoff at 10, rue Madamoiselle, Paris, at a cost of 3s. 4d., plus postage.

BRITISH STANDARD

A new British Standard has recently been published, B.S. 1772:1951. The specification covers the sizes of photographic sheet film, other than X-ray film.

NEW EQUIPMENT

As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.

THE KELLY CINE CALCULATOR

IT has long been my view that a form of calculator, or slide rule, supplying answers to the several purely mathematical problems which confront the cameraman both in and out of the studio, would save a good deal of time and allow him to devote more thought to the artistic and creative side of his job.

I consider this need has been satisfied by the new Kelly Cine Calculator. This calculator is designed to be carried in the pocket and consists of an opaque circular base $4\frac{1}{2}$ inches in diameter on either side of which are rotatably mounted transparent circular discs. The two discs thus provided being capable of rotating independently so that scales engraved on these discs may be adjusted relative to scales on the base.

The base scales are engraved in black on a white ground, whereas the top scales are engraved in red on a transparent disc. In this way a red figure lines up with a black figure and makes for rapid readings. The total thickness of the three discs is approximately 0.1 inch.

The front side of the calculator supplies hyperfocal distance and depth of focus, at all apertures and distances, for seven lenses.

On the reverse side are carried seven more scales respectively:—

- (1) Film used per second, 16 mm. and 35 mm. in both metres and feet.
- (2) An aperture scale from $f/1$ to $f/32$ in thirds of a stop, plus equivalent Technicolor stops from T1 doubling to T64.
- (3) A filter factor scale ranging from 1.5 to 16. This scale also carries, by name, ten of the more commonly used filters.
- (4) Shutter angles from 5° to 280° .
- (5) Camera speeds expressed in times normal from $1/24$ times to 16 times and also in frames per second from 1 to 384.

- (6) Incident Key light in 31 steps from 12 to 12,800 foot candles.

Scales 3, 4, 5 and 6 are all used in conjunction with the aperture scale and allow for exposure compensations to be made for almost any circumstances. The seventh scale on this side gives height and width of



picture area at distances from 1 to 500 ft. when using any one of 14 different focal length lenses.

It is interesting to note that the amount of information carried on this calculator requires something like forty pages of printed matter within contemporary books of tables.

There is a tendency for grit to find its way between the discs, which require blowing out with an air line from time to time, and it would be an improvement if some kind of transparent washer could be incorporated between the outer edges to serve the dual purpose of keeping dirt out and preventing direct contact between the outer edges of the discs which might tend to wear off some of the scales.

I have also handled the 16 mm. version of this calculator, and it would appear to do for the 16 mm. cameraman all that is claimed for it. Suffice it to say that, using one of these calculators, I have found it greatly facilitates the little 16 mm. work I do at home.

The fact that these calculators were designed by W. B. Pollard, B.A., and produced by Skeets Kelly, both of whom are professional cameramen of many years' experience,

leaves little doubt of their accuracy and practicability.

The large amount of information carried on the calculator, its portability, and its red and black figuring, which makes it readable at a glance, will appeal to all cameramen who do not want to waste time in working out these problems at the expense of more important considerations, such as lighting and composition.

F. A. YOUNG.

THE COUNCIL

Summary of meeting held on Wednesday, September 5, 1951, at 117 Piccadilly, W.1

Present : Mr. B. Honri (*Vice-President*) in the Chair, and Messrs. H. S. Hind (*Deputy Vice-President*), N. Leevors (*Hon. Treasurer*), F. S. Hawkins, R. E. Pulman, S. A. Stevens and I. D. Wratten.

In Attendance : Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from the President and Messrs. F. G. Gunn, T. W. Howard and A. W. Watkins.

COMMITTEE REPORTS

Membership Committee.—The following are elected:

Herbert Harold Allen (Associate), Odeon Theatre, Bath Road, Hounslow West.

Charles Brian Watkinson (Member), "Film User," 174 Brompton Road, S.W.3.

Felix Vivian Royce (Member), Zonal Film Facilities Ltd., Central Buildings, 24 Southwark Street, S.E.1.

Alan Montague Gummer (Member), Philips Electrical Ltd., Century House, Shaftesbury Avenue, W.1.

Prithvi Chande (Associate), Eastern Movies, 72 Queensway, New Delhi.

Gordon Henry Bell (Associate), Engine Department, R.M.S. "Caronia," Cunard S.S. Co. Ltd., Southampton.

The following transfers from Associateship to Membership are approved:

Alfred Henry Dossett, Studio Film Laboratories Ltd., 71 Dean Street, W.1.

Nicholas Meldrum Banton, Educational Film Department, Government of British Columbia, Canada.

The resignations of three Members, two Associates and two Students, and the death of two Associates are noted with regret.—*Report received and adopted.*

Education Committee.—Two courses of instruc-

tion are planned for the 1951/52 Session. The first, a series of six lectures on "Kine Camera Technique," to commence on October 15 at Ealing Studios, and the second, a series of six lectures on "Sensitometry," to commence in January, 1952.—*Report received and adopted.*

Branches Committee.—The Chairman of the Committee, Mr. R. E. Pulman, is in the process of visiting each of the Sections to exchange views and discuss future policy with the Local Committees.

An offer is under consideration to form a B.K.S. Group in Australia.—*Report received and adopted.*

Journal Committee.—The Committee is responsible for all the Society's publications and in order that its name shall more clearly interpret its function, it will in future be known as the "Publications Committee."—*Report received and adopted.*

Theatre Division.—The *Ad Hoc* Committee continues with its work of drafting a syllabus in connection with the Joint Scheme for the Apprenticeship and Certification of Projectionists.—*Report received and adopted.*

Tele-Kine Group.—A meeting of the Co-ordinating Committee is arranged to take place on September 17. The representatives of the two Societies are as follows:

British Kinematograph Society—Messrs. G. Burgess, W. Cheevers, M. F. Cooper and R. E. Pulman.

Television Society—Messrs. H. W. Baker, L. C. Jesty, T. M. C. Lance and R. C. G. Williams.—*Report received and adopted.*

Institution of Electrical Engineers.—Messrs. B. Gamble and R. E. Pulman are appointed to serve on the Joint B.S.I./I.E.E. Committee which is to draw up a code of practice of kinema safety lighting.

The proceedings then terminated.

BRITISH KINEMATOGRAPHY

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THE 16mm. FILM DIVISION

THERE can be no doubt that 16mm. film continues to grow in importance and application. From amateur beginnings, it has now become a truly professional medium. 16mm. can, in fact, be regarded as the new standard gauge on which that vast class of "non-theatrical" films is shown, quite apart from the growing number of entertainment films which are to-day screened in 16mm. There is an obvious need for an organisation catering for the technical requirements of those engaged in this field and the 16mm. Film Division of the Society attempts to meet this need.

A glance at the lecture programme will give some idea of its scope, but the work of the Division extends far beyond this. For instance, a Committee of Inves-

tigation in the field of 16mm. presentation is at present in being with no less than four Sub-Committees covering, sound, photographic technique and projection, as well as details of presentation. Through the Society, the Division also maintains close collaboration with the British Standards Institution whenever matters affecting 16mm. film in any of its aspects arise.

So, by providing a means of disseminating and exchanging information and stimulating discussion and technical thought, through its meetings and committees, the object of the Division is to raise and maintain the standard of 16mm. technique throughout the industry at all stages.

DENIS WARD, B.Sc., Ph.D., M.B.K.S., F.R.P.S.,
Chairman, 16mm. Film Division,

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A PHOTOGRAPHIC TECHNIQUE FOR PRODUCING HIGH QUALITY 16mm. PRINTS

A. Tutchings (Member)*

Read to a meeting of the 16mm. Film Division on November 14, 1951

DURING the war the Telecommunication Research Establishment maintained a film unit to produce training films on equipment designed and developed within the establishment. Because of the nature of the work, these films were shown mainly to R.A.F. personnel. Most of the films were on 35 mm. negative and distribution copies were optically reduced to 16 mm. A few colour films were made on 16 mm. Kodachrome and distributed as Kodachrome reversal dupes.

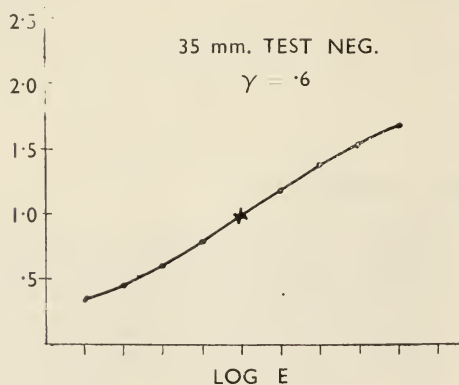


Fig. 1

Since the war the unit's programme has been broadened to include the making of films for a number of other government establishments. Most of these films are shown to industry to introduce techniques and ideas which simplify or speed production. A number of research record films are also made for use within the establishment or for loan to universities or other research groups.

Projection facilities in the Services, in industry, and in the Universities are almost exclusively 16 mm. For this reason it was decided to produce all T.R.E. films on this

gauge. A standard S.M.P. & T.E. print, projecting with emulsion out, was desired, and all the "optical" facilities used in 35 mm. film making were to be retained. The final objective was a 16 mm. print inferior to a 35 mm. print only in the inevitable slight increase of grain in the picture and slightly increased noise on the sound track. Tonal range on picture and frequency range on sound were to be comparable.

Commercial Printing

It was first necessary to find the reason for

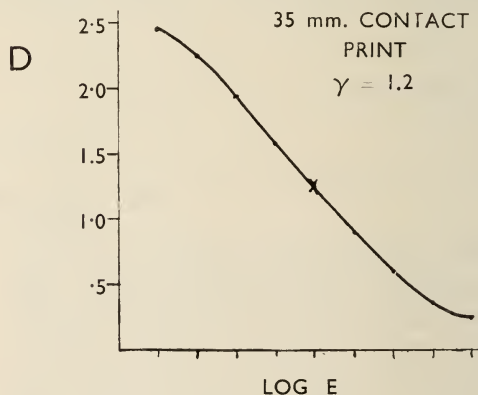


Fig. 2

the low quality of many 16 mm. reduction prints. For picture checks a light box, faced with a transparent step wedge, was photographed on 35 mm. negative so that single frame gamma strip negatives were available. One such frame was cut into the leader of each film sent for printing and over a period of about six months an average print gamma curve was established for each kind of printing process.

The curve of the test negative which was adopted as standard is shown in Fig. 1. The range covered is slightly larger than the

* T.R.E. Film Unit, Ministry of Supply.

average properly exposed negative which is usually within the range .5 to 1.5. Fig. 2 shows a 35 mm. contact print on 1302 stock. This is the ideal to endeavour to obtain in the final 16 mm. release prints.

Typical reduction prints from the same negative for three printer light settings are shown in Fig. 3. It will be seen that, irrespective of the printer light used, the whites are seriously compressed. Later tests on the T.R.E. optical printer showed that this is due to light scatter in the printer lens system, and that the effect can be markedly reduced by not stopping down the lens and working it near full aperture, and to a smaller extent by "blooming" it.

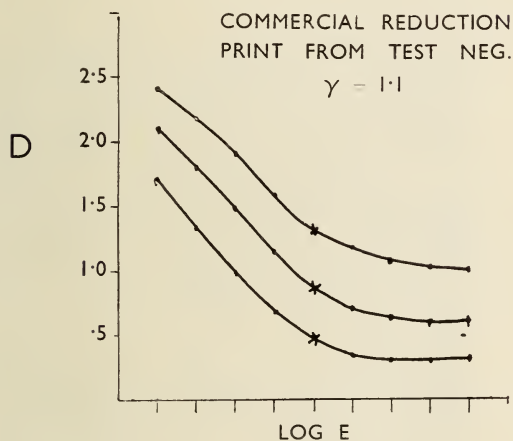


Fig. 3

The final overall gamma curve obtained by reducing the contact print of Fig. 2 to a 16 mm. negative and contact printing to 5302 is shown in Fig. 4. This explains the typical "soot and whitewash" appearance of prints made in this way.

Tests on sound quality were almost equally depressing. A constant amplitude frequency run variable area negative, contact printed to 1302 and played on a standard 35 mm. reproducer with a 1.2 thou. scanning slit, gave the response shown in Fig. 5a.

The same negative, optically reduced to 5302 and played back on a 16 mm. reproducer with a .5 thou. scanning slit, gave the response shown in Fig. 5b. The gain and

signal to noise ratio was also down by 6 db when compared with a 16 mm. direct positive of the same density. This low gain and poor frequency response on optically reduced variable area sound is also thought to be due to light scatter in the reduction lens.

Variable density sound suffers less frequency loss in optical reduction, but gain losses up to 10 db were measured. Speed fluctuations in optical printers are also very troublesome. One seems to have a choice of sprocket ripple or "flutter" with very little "wow" or an abundance of "wow" and no "flutter," depending on the printer used.

T.R.E. Procedure

It was obvious from the curve of Fig. 4

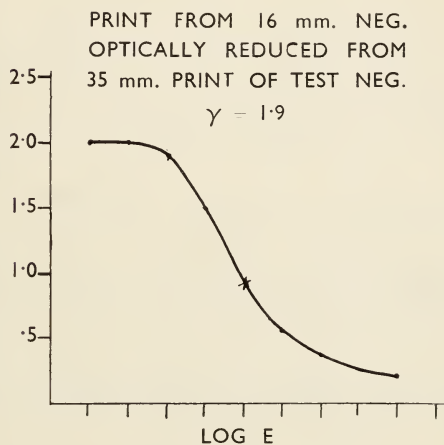


Fig. 4

that further work had to be done on the negative-positive duplicating process mainly in the direction of reducing the overall gamma, and minimising the effect of light scatter in the optical printer.

It was first necessary to decide between negative-positive and reversal for the original 16 mm. filming. Both covered about the same tonal range. A slight resolution loss was found in the contact printing of the negative-positive although grain was slightly less than reversal. The final deciding factor proved to be the effect of dust and scratches on the films. On reversal the small specks were black, and were much less obvious on projection than the white holes or lines pro-

duced by dirt on the negative. All original filming is therefore done on Super X reversal stock, and this is processed by Kodak to give the positive original.

A single frame gamma strip obtained by filming the light box gives the curve of Fig. 6. It will be seen that it is reasonably linear plus or minus four stops from a mid point density of 1.2. It should be remembered that this curve includes the effect of any light scatter in the camera lens, and is a true measure of the tonal range of the film in practical use. A very consistent gamma of 1.0 to 1.2 is maintained by Kodak processing. All processing is uncompensated unless specially asked for.

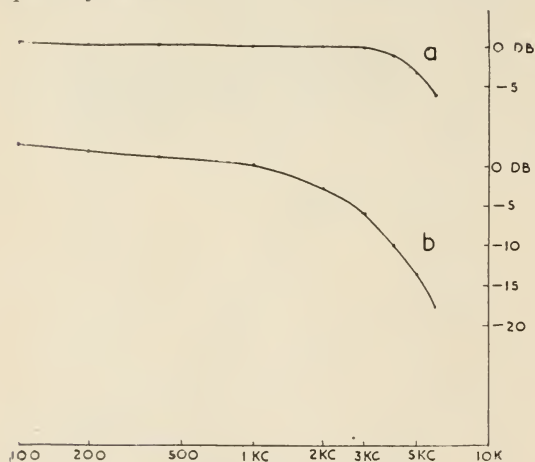


Fig. 5

"Original" film is screened once only, and selected shots are immediately printed to reversal cutting copy "dupes." As these "dupes" are only used for cutting, editing and commentary timing, ordinary 5301 positive stock is used for cheapness and convenience. Standard D16 baths are used for first and second development, and the only addition to the processing sequence is a weak initial fogging light, a bleaching bath and a more powerful reversal light. These cheap reversal dupes are surprisingly satisfactory.

Sound is recorded as variable area negative on 5301 stock, which when printed with the picture on to 5302 release positive, yields a standard S.M.P. & T.E. print (emulsion out). Most sound is re-recorded from mag-

netic tape. This leads to a substantial saving of stock and processing, particularly in synchronised sound sequences.

The Picture Negative

The "master" 16 mm. picture negative which is printed with the sound is really the key to the whole process and will now be described in some detail.

5504 reversal duplicating stock is used, but it is, of course, processed as a negative. It was chosen because it handles well without scratches or stress marks. The rather thinner emulsion and yellow tinted base lends itself to very low gamma processing, and, being blue sensitive only, it can be handled in an ordinary safelight during printing and processing.

If a contact print is made from the "original" reversal positive a negative is obtained with an emulsion position suitable for S.M.P. & T.E. prints. A control gamma of .6 is used, and the printer light is set to give a mid range density of .5 to .6 with top and bottom densities of 1.2 and .1 (Fig. 7). When printed to 5302 release positive the mid-range density is printed to 1.0 to 1.2 with top and bottom densities of 2.2 and .2 (Fig. 8).

Linearity and tonal range are comparable with the reversal original, and on projection the main impression is of a slight increase in brightness due to the clearer whites of the negative-positive dupe as compared with the slightly yellow tinge of the reversal original.

As mentioned earlier, "opticals" in the form of mixes, fades, superimposition, etc., were required so that optical printing had to be considered. Tests showed that optical printing stepped up the contrast by a factor of about 1.5, therefore to obtain a "master negative" gamma of .6 it was necessary to drop the processing gamma of the 5504 dupe negative to .4.

The commercial laboratory handling T.R.E. processing found that their machines had to be speeded up quite considerably to reach this rather low gamma, and it was through their co-operation that the process became practical. The optical dupe negative

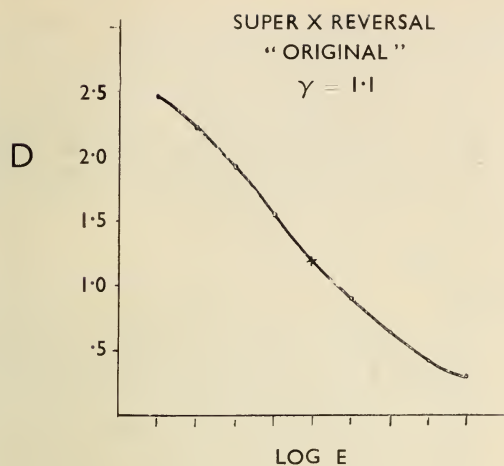


Fig. 6

is almost identical with the contact dupe negative of Fig. 6. Fig. 9 shows a print from this negative superimposed on the original reversal positive. It will be seen that it matches within $\pm .1$ over most of the range.

This optical dupe negative is sufficiently satisfactory to allow the complete master negative to be produced via the optical printer. A very detailed doping sheet is compiled from the final cutting copy to include all mixes, fades, etc., together with light changes to match scene brightnesses. By changing the projector gate of the optical printer, 35 mm. library material may be inserted or mixed with the 16 mm. original.

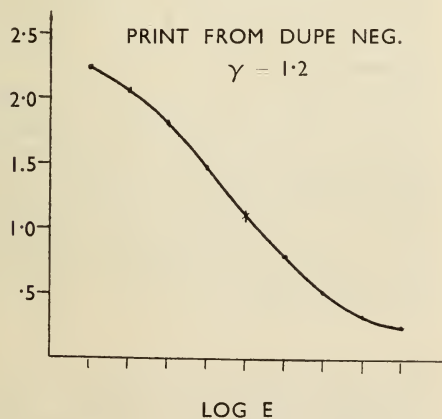


Fig. 8

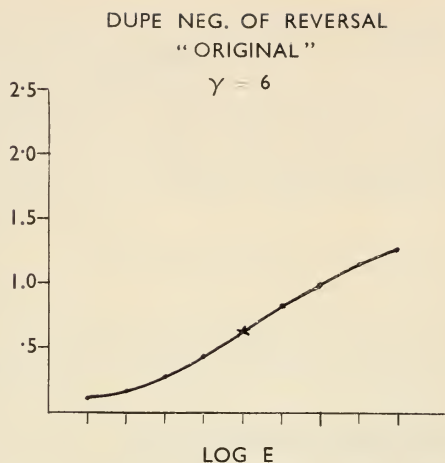


Fig. 7

In the same way Kodachrome and negative-positive prints may be used if desired. A splice free master negative is thus obtained which goes through the printer at a fixed light.

Special leaders are printed at the beginning and end of the negative which includes printer synch. marks for matching to the sound negative, and test frames for specifying the exact printer light to obtain a proper density release print. Normally a .5 density test frame on the negative is printed to 1.2 on the print. For use on poor projectors or projection in a high ambient light this density may be specified as low as .9.

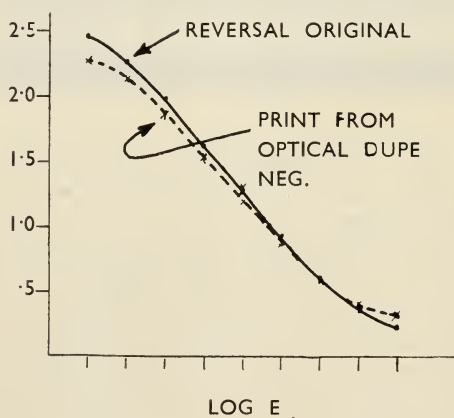


Fig. 9

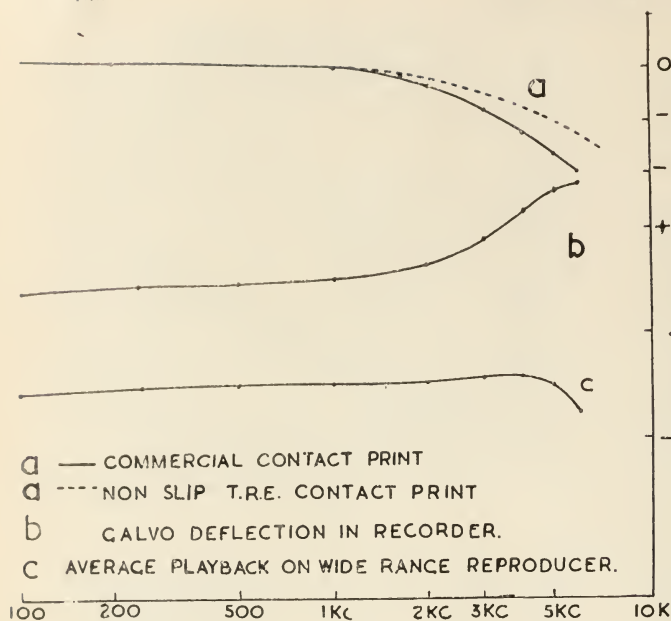


Fig. 10

The Sound Negative

A 16 mm. constant amplitude variable area sound negative printed on commercial contact printers shows a loss of 7 to 8 db at 5 Kc when played on a wide range reproducer,

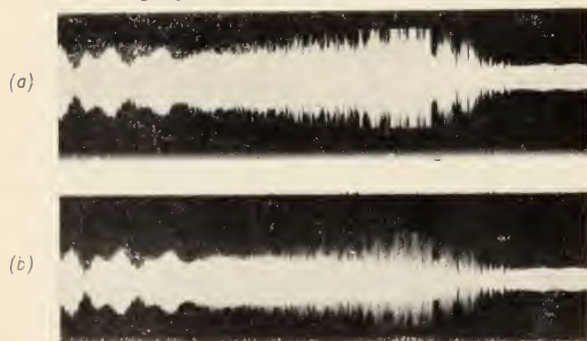


Fig. 11

Fig. 10a. Pre-emphasis is used in recording Fig. 10b, to give an overall level response to 5 Kc, Fig. 10c.

There is still plenty of room for improvement in commercial contact printers. An experimental non-slip printer developed at T.R.E. shows 3 db less loss at 5 Kc and frequencies up to 7 Kc are clearly resolved. Fig. 11 shows a piece of speech waveform containing a sibilant of roughly 7 Kc printed (a) on the T.R.E. printer and (b) on a com-

mercial sprocket printer. It is seen that due to film slippage the 7 Kc waveform is completely lost. The non-slip printer also eliminates sprocket modulation which is audible to a greater or lesser extent on all commercial prints.

Future Work

A 7 Kc sound waveform corresponds to a resolution of only 40 lines per mm., so that it is obvious that, in continuous motion printers, the picture resolution is also degraded to about 30 lines per mm. or less. Work is now in hand to measure the picture resolution improvement on a frame by frame printer as compared with the continuous motion sprocket driven type.

First indications are that with a good, sharp negative the improvement is quite noticeable.

Further work is also required on the optical printer to reduce the step up in contrast. Near ultra violet light combined with a slightly redesigned bloomed lens seems to offer hope of substantial improvement.

Sound track negative splices are difficult to quieten except by flash blooming the print, and few commercial 16 mm. printers have this facility. Experiments with diagonal splices show some improvement, but undoubtedly the final answer is a splice-free sound negative dubbed from the original magnetic recordings.

Conclusions

The work described in this paper has shown that it is possible to produce high quality 16 mm. films by careful attention to the sensitometry and processing of the dupe negative, and that the factors needing attention in commercial printers are light scatter in reduction printer optics and film slippage in contact printers.

Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this paper.

The Vote of Thanks was proposed by Norman Leever, Chairman of the 16 mm. Investigation Committee, who contributes the following notes:

It is important to bear in mind that in commercial work non-technical factors may have an overriding importance. Many laboratories have the technical knowledge and facilities to carry out work to the highest quality requirements; but we must expect to pay higher rates to correspond. No doubt most film producers are keen to obtain

quality and are prepared to pay extra for very high grade work. If the large consumers of prints would always put print quality before cheapness, the laboratories would have a real opportunity to give us the full benefit of their knowledge and facilities.

DISCUSSION

— ROE: In Fig. 9 the print made from the optical reduction dupe negative was compared with a reversal original. Surely it would be better to compare it with a positive duplicate. I think there is closer comparison between a direct optical print and the optical reduced print than between the optical reduced print and the original reversal.

THE AUTHOR: The only print I showed with a gamma curve was 35 mm. I compare it with the reversal original because that is really what we try and do with the copy.

— ROE: Actually you do put everything in the optical print. Not everybody may do that.

THE AUTHOR: No.

R. M. HARRIS: If there is any reason for choosing reversal as a material for use in these films, I suppose it would be the dust problem. You said they probably compared as far as range was concerned. My experience has shown differently. I think negative has a much longer range of tone values, particularly on high contrast scenes. If dust blemishes are the only reason for reversal being chosen as a medium for making your films, I believe these can now be overcome, and secondly opticals can be done on 16 mm. negative. The latter is now universally favoured as being a more convenient system, and a great improvement on duplicates from reversal.

THE AUTHOR: The dust was one of the reasons; the other one was that we wanted a standard emulsion position print, and if we were first to shoot our picture on negative it would mean one more printing process and one more loss in the contact printer. We tend to lose about 30% resolution on each printing process. Although we have not really checked it yet, we feel we shall lose more resolution by going to the third generation prints (starting with negative, printing a positive, optically printing that to a negative and contact printing that to a positive again) than we should lose on the reversal. We would rather have the lack of dust and the relatively better definition than the slightly wider light range.

We went into the difficulties of handling negatives and the dirt that it picks up and the way the dirt showed up. We had to come down on the side of reversal.

R. M. HARRIS: My question is answered except on the matter of standard prints. Many people think that you can use a non-standard print with quite good results. In fact, it is very difficult to decide to the listener in the theatre whether it is a standard on non-standard sound track. There

is at least one projector on the market on which the focus of the sound system can be altered to correspond.

THE AUTHOR: During the war we produced a lot of non-standard prints in colour with a variable density sound track, and we found the sound appallingly bad on quite a lot of projectors, because you could not re-focus the sound. It depends on the depth of focus of the optical system of the projector. If it is a physical slit with a fairly long focal length, I believe it doesn't make very much difference. We have measured the difference on these very good optical systems of not much more than 3 or 4 db, but on some of very short focal length with very sharp cross-over of focus it can be as bad as 10 db down at 5 Kc, which makes it seem very muddy indeed unless you can re-focus the sound. I think there is only one commercial projector on the market in which you can re-focus the sound. In any case, one of the objectives we have set ourselves was that we must have a standard emulsion position on the print.

L. H. G. BROWN: Surely in optical printing it is possible to arrange the emulsion on either side?

THE AUTHOR: We cannot afford to put every film through an optical printer. Another advantage of the shooting on reversal system and keeping that reversal in our own hands is that we can make any number of these master negatives. If we need a very large number of prints, then we can make any number of negatives before the original wears out. Going back again to the only experience we have had of reversal duping. Some of our early war-time films went up, I think to 158 copies. You can imagine the original reversal was pretty badly worn; 50 to 100 was usual from such an original.

A VISITOR: I wish Mr. Tutchings would say more on his theory of light scatter.

THE AUTHOR: Whether we are using the optical printer as a reduction printer or as a one to one printer, there is a step up in contrast due to the scattering effect of the emulsion, and all we are suggesting people do is in some way to compensate for that step up in contrast when they make the negative. I know that in 35 mm. it is standard practice to compensate for that step up in two stages. The first is to make a soft low density positive and from that make a low contrast negative so that the overall duping process gives a gamma of slightly less than 1, which stops any slight step up in contrast. That is 35 mm. pro-

cedure, and is designed to allow for the effect we get in optical printers. But on lots of 16 mm. work the same care isn't taken because we have not the same duping stock available. They tend in making a dupe negative from the original 35 mm. negative to push it through a standard bath, giving it a gamma of .6, and that, when it has gone through the optical printer, gives us a gamma of .9. It has gone up $1\frac{1}{2}:1$. The laboratory should try to compensate for this in some way. The way we are doing it is by using a short development time in the dupe negative. That is the only way we can find of doing it. You can get the same gamma effect in other ways: by using ultra-violet light on the printer or very diffused light, but even with that you have to make some allowance for the step-up in the printer. The light scatter effect in the printer tends to almost compensate for that effect on one part of the scale. In other words, it flattens off the slope of the curve at the low densities. Some of the laboratories seem to be quite satisfied that that compensates for the step up in contrast. In actual fact, it glares light all over dark parts of the print and kills the details in the light parts.

R. H. BOMBACK: I think it is always easy to generalise in discussing laboratories. It is a little dangerous when you refer to the number of our laboratories. Can you give the number of laboratories you have been tested at?

THE AUTHOR: Five over a period of about six months. The curves are an average of these.

R. H. BOMBACK: I am most surprised at your implications that some laboratories do not understand this business of contrast printing. I should have thought it would have been well known.

THE AUTHOR: We are very anxious to find out what the laboratories do. We are just starting up again in the 16 mm. Investigation on Picture, and we are very anxious to get co-operation from the laboratories to find out what are their standard processes. I did all this work before I joined the B.K.S., before I knew about these sub-committees, so that these are my own ideas, and not those of the Investigation Committee. But we would like to carry out further tests with the co-operation of the laboratories, if we can have that co-operation. We did these tests quite soon after the war, when perhaps the laboratories were short of staff, and results are a fair average. It really was heartbreaking to make a film on 35 mm. and get results on 35 mm. prints, and see on these all the bright, clean detail which we knew the cameraman had put into the film, and then see the average 16 mm. reduction print. There was absolutely no comparison. It was that which decided us to shoot the stuff on 16 mm. We knew we should get results on 16 mm. which were as good as, if not better, than the average 35 mm. reduction prints. We should like to do the investigation again in view of recent advances in technique.

R. H. BOMBACK: Just one further point with regard to your curves. I think the size and shape of your characteristic curves is incomplete. I should like to see what happens at densities below .3 or .4. That is very important.

THE AUTHOR: The tests were done by the nine step range, which was photographed on the nega-

tive and we didn't carry them any further than that.

R. H. BOMBACK: If I may come back to that point. It's amazing in a test of that sort you use such small areas on the frame. It is very difficult to rely on a system of that sort because of your directional effect. Did you, in fact, take any particular precautions about that? In trying to process a piece of film in this way it is very difficult in fact to get a resolving power at all satisfactory.

THE AUTHOR: Well, we had to go in our general frame because a lot of the effects were due to the scatter of the light passed on to the dark parts, and doing it on different frames by putting the usual long gamma strip along the film, although it is much easier to measure, means that each frame is printed without light from any other part of the picture area falling on it. We felt we had to do it on the single frame. We did make the usual tests of putting the gamma strips head to tail as they went through the bar. We also made measurements on the mean density surrounding the strips to make sure we were not plotting them with a lot of light from the surrounds. On the whole, we were satisfied that they did represent pretty well what was actually happening on a single frame on the film. They seemed to tie up with our visual estimates of what the picture would look like. If the gamma strip showed that the light were compressed, then usually the picture looks that way as well.

— HUGH: I would like to ask a question on the matter of the illuminated wedge. I similarly use an illuminated wedge on 16 mm. stock I shoot. It is a continuous wedge, with a density gradient rise of .1 every 5 cms. and the wedge itself is about 8 to 9 ins. long. I expose this on Ilford stock and the point I had experienced some difficulty with is the control of the illuminant in the wedge. By measuring the differential on the resultant negative, it is possible to assess a close approximation to gamma. The lantern has high intensity enlarger lamps. One of them tends to a reduction in luminancy which is greater than the other. I was wondering how you illuminated your set?

THE AUTHOR: I think that is very important indeed, because it comes to the same problem of the optical printer. Whether illuminating the wedge with very diffused light or with specular light. I expect that if you use an enlarger with more or less parallel light hitting the wedge, you will be measuring on the film a rather higher gamma than the gamma I was getting with very diffused light. We are, in fact, using an ordinary Kodak sledge light box, where the light is in the bottom of the box and that is shown up on the matte white piece behind the normal safe light. Our set wedge, which is again about 9 to 10 ins. long, is across the middle of that. We have checked without the wedge in by photocell, and it is an even illumination. The gamma we actually measure in film (1.1, 1.2) is very nearly the same gamma that we measure with an ordinary sensitometric wedge put directly on the film. If there is any error in the measurements at all it is due to the slight specularity of the light we are using to illuminate the wedge. Once we have got

the original gamma strip on a single frame of the film all that really concerns us is to reproduce what we have through the optical printer or negative/positive duplicating process. I should say in your case you had better use more diffuse light than the parallel light you probably are using.

— HUGH: The lantern was designed for me by Ilford, Ltd., and the lamps are in a lantern box

and are screened. I have difficulty in getting adequate density.

THE AUTHOR: With a 200 w. lamp in this job, we simply filmed it at f1 24 frames per second, and it gives us the things we showed in the curve. The bottom density of about .2 and the top one roughly .5. It more than covers the range we normally get from a studio scene.

A METHOD OF MAKING TRAVELLING MATTES USING A SINGLE - FILM CAMERA

G. I. P. Levenson, B.Sc., Ph.D. (Fellow)* and N. Wells*

IN 1947 the Kodak Research Laboratories were invited by the J. Arthur Rank Organisation to collaborate in a programme of work on the establishment of a technique for use in making travelling mattes for special effects work in motion picture film production. The matte process has been employed by several companies, but the details of the procedures used have hitherto not been divulged.

INTRODUCTION

The matte is a device for combining the elements of two (or more) scenes into one finished scene by multiple printing using a silhouette image of one of the scenes as a protective mask when printing the other. It is most easily described by taking a particular example. Suppose it is required to show on the screen a man moving in a given scene and for some reason it is not convenient actually to photograph him in that scene. The required composite result can be obtained in the following way. The general scene is filmed or a negative is obtained of the *background* shot. A shot is then made of the man acting before a plain backing. This shot is lighted so that the luminance of the backing is greater than the luminance of any part of the man or, more generally, of the *foreground* subject. The conditions for the illumination of the foreground subject are

shown in Fig. 1. This shows the characteristic curve of the foreground negative. Let FH represent the brightest highlight in the foreground subject, and B the plain backing.

The density differential between FH and B is then used in preparing a silhouette print from the foreground negative in such a manner that all the tones represented by the characteristic curve up to FH are reproduced as an effectively opaque density, while B is reproduced by clear film. The characteristic curve of a silhouette is shown in Fig. 2.

Composite Print

To make the composite print, the background negative is sandwiched with the silhouette matte and is printed on to positive stock. The area covered by the silhouette must not register an exposure, and for this reason the silhouette can be considered opaque if its density exceeds 2.0. Then the foreground negative is printed on to the same positive stock taking all possible care to ensure a good registration between the image and the unexposed space left by the silhouette. If these steps are properly taken, the developed print will show no trace of outline to betray the fact that it carries a composite image.

It is probably apparent by now that the difficulties met in practice will be associated

* Kodak Research Laboratories, Harrow.

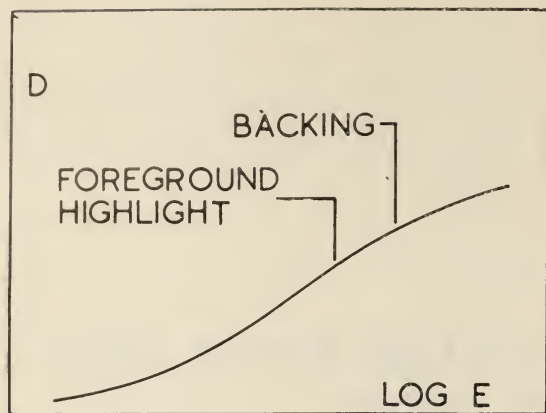


Fig. 1

Characteristic curve of foreground subject negative showing disposition of foreground highlight (FH) and backing (B) images.

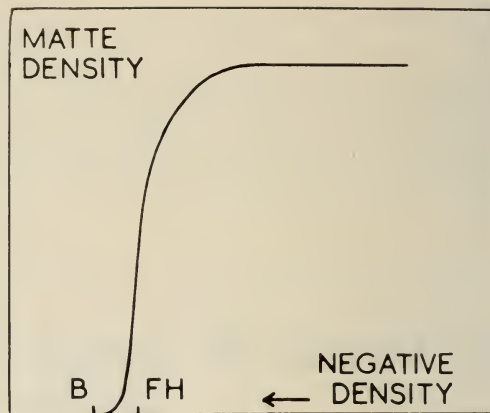


Fig. 2

Diagrammatic characteristic curve of silhouette image.

with the provision of an adequate luminance differential on the set between the foreground subject highlight and the plain backing; with the dimensional characteristics of the images at the various stages resulting from light scatter in the emulsion; and with dimensional changes due to shrinkage effects in the film support.

The difficulty of lighting the foreground set so as to obtain an adequate separation between background and foreground highlight luminances can be largely avoided by using a colour separation. If the foreground subject is separately lit by yellow light and the backing is blue, a very large effective separation is obtained if the scene is photographed using a blue-sensitive film. In this case it is necessary also to use an ortho- or panchromatic film in order to expose on the yellow-lit foreground subject. In practice this involves the use of a beam splitter camera for running the two films in order to avoid the loss of resolving power entailed in running the two films in bi-pack form.

Split Beam Camera

A process of this sort has been used by T. W. Howard¹ for a number of years with considerable success. Howard has worked from the master negatives taken in a Technicolor beam-splitter camera. The use of a beam-splitter method, though achieving

suitable negatives for matting very easily, does of course presuppose the existence of such cameras, and they are very scarce and costly pieces of equipment. The travelling matte process could be more readily employed if ordinary cameras could be used.

We were asked to examine the possibilities of making mattes from negatives obtained in an ordinary camera, while the J. Arthur Rank Organisation studied the beam-splitter process. The latter project has been brought to a successful conclusion, and is now in commercial use.² The work described below indicated that it is possible to make mattes of the required characteristics from the single foreground subject negative by pushing the photographic methods to the limit of their capabilities. Although the processes have not yet been tried in a motion picture production, it is thought that the data should be placed on record in case they may be of use in special circumstances.

MATting FROM THE ORIGINAL NEGATIVE

In the experimental method that is the subject of this paper, the foreground subject was photographed normally using white light. When the negative had been processed it was printed on to fine-grain stock having a very high contrast. The print was again printed on to the same type of film, but this

time the exposed film was reversal processed. In this way it was possible to raise the gamma of the matte to 25, though in practice the effective slope was nearer 5 because of the necessity of working on the toes and shoulders of the characteristic curves at the various stages.

There was an alternative course, namely, to make a reversal negative of high contrast and then to print this again in order to obtain the final matte. This method was found to lead to a marked change in image dimensions because the adverse effects of light spread in the emulsion during printing occur

Laboratory Experiments

The laboratory "set" consisted of a sheet of film 12ins. by 15ins. carrying twelve square patches of image density, each patch being 5 cms. by 5 cms. (Fig. 4). The clear area of film represented the backing on the set, while the graded patches represented tones in the foreground subject. The sheet of film was placed in front of an opal illuminator. A Retina camera was mounted opposite to the illuminated film at such a distance that the image of the test object occupied an area equal to that of a standard 35 mm. frame.



Fig. 3

The three stages of obtaining a matte from a foreground subject.

in the same direction at both stages. In the preferred procedure the increase in size of the image that occurs on making the print from the negative is offset by the opposite change that takes place on making a reversal print from the intermediate print. The stages of the process used in this work are shown in Fig. 3.

Some preliminary experiments made at Pinewood Studios indicated that this method showed promise, though the maximum resolution obtained was 20 lines per mm., whereas Howard considered that 45 lines per mm. should be attained in order to effect perfect matting. Because of the laborious nature of the studio experiments, apparatus was constructed to carry out the work in the Research Laboratory at Harrow.

The illumination of the opal was carefully adjusted, and tested by photographing it on to a contrasty stock, until the density of the processed image at a level of 1.8 and at a processing gamma of 5 was uniform across the frame area to within less than ± 0.05 density unit. This form of adjustment automatically compensated for lens vignetting in the camera.

The Retina camera was tested to ensure that it was capable of resolving more than 45 lines per mm. Within the field used it was found capable of giving up to 60 lines per mm. at f.3.5, on Panatomic-X film, though in the actual work it was found better to operate it at f.8. The camera was focused by making a series of exposures at different

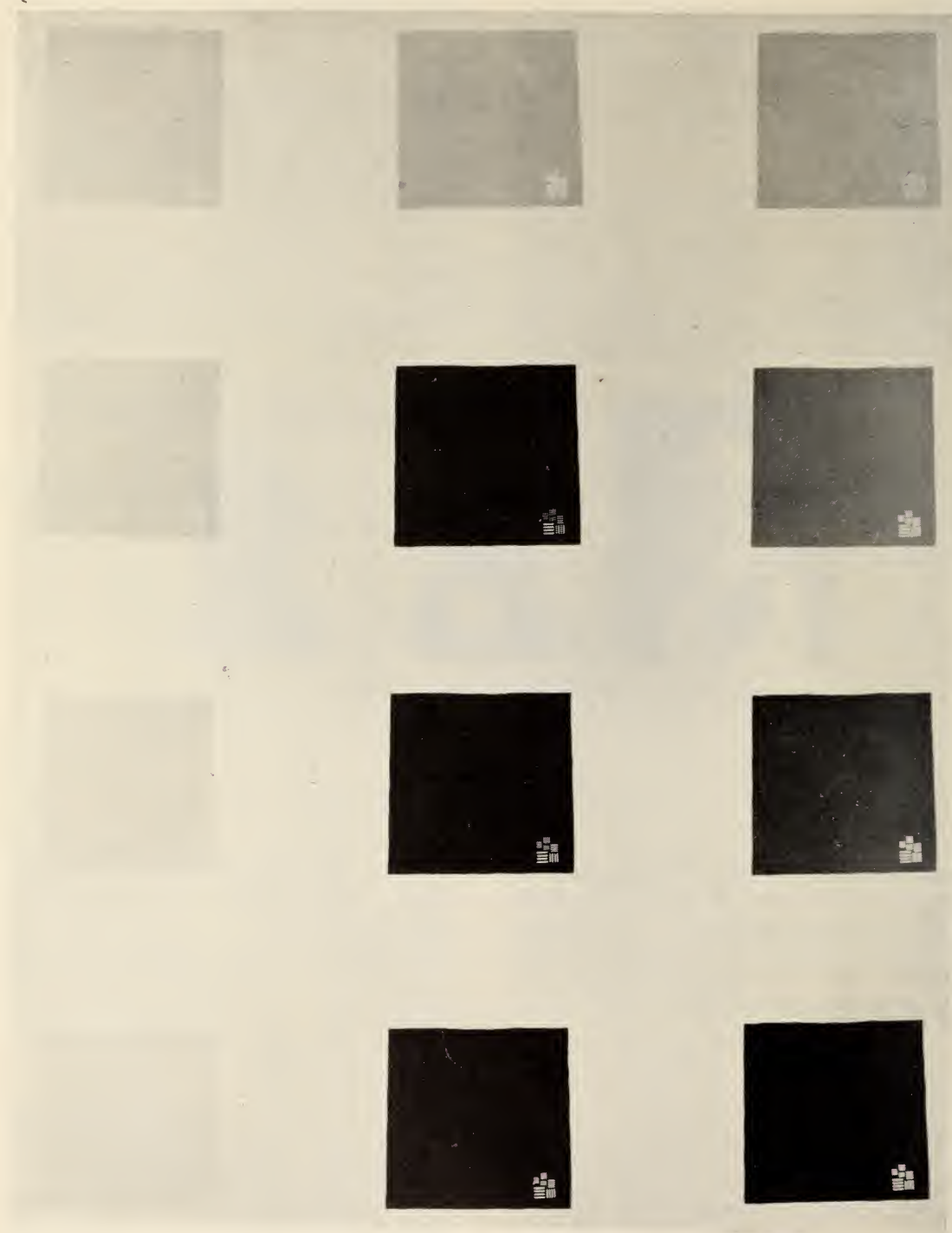


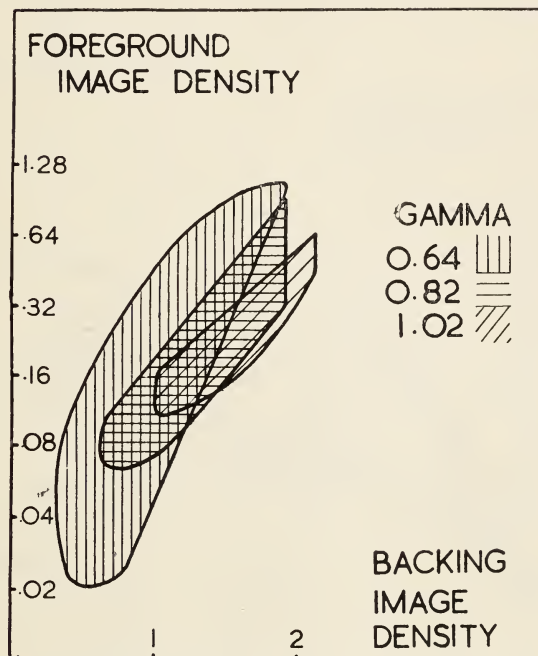
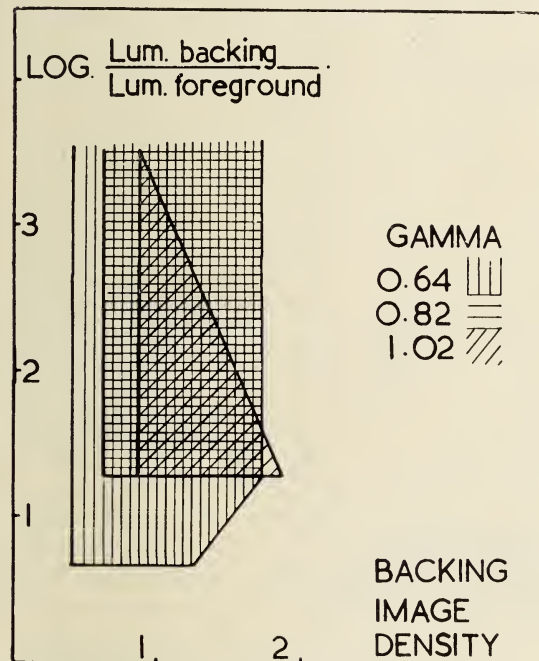
Fig. 4. The test object.

settings and selecting the correct setting after inspecting the processed negatives.

The densities of the twelve patches on the test object ranged from 0.07 to 3.50 above the density of the film base though nine of the patches had densities lower than 1.0 because this was the most important range. As stated above, the clear film space between the patches represented the illuminated backing used in a studio foreground set. The

1. Negative exposure.
2. Negative gamma.
3. 1st printing exposure (working to maximum gamma).
4. 2nd printing exposure (working to maximum gamma).

on the dimensional and tonal characteristics and on the resolution of the images at each stage. Since the scheme needed to start with negatives at three gamma levels and several exposure levels at each gamma, the number



Figs. 5 (a) and (b).

Images having a resolution of 40 lines per mm. can be obtained inside the three hatched areas. The limitation of the range on raising the gamma was an unexpected result occasioned by a clogging-up of fine detail.

patches represented tones in the actual foreground subject. Since the resolving power of the process with respect to the outline of the foreground subjects depended in the first instance upon the luminance contrast between the outline of the foreground and the brighter backing—if they were both equally bright there could be no resolution—each patch carried a small resolution chart in one corner.

The object of this part of the work was to survey the effect of

of combinations leading to final mattes would be enormous. Consequently, at each stage, those frames were weeded out which did not satisfy arbitrary standards of resolution. Both Background X and Plus X films were used for making the negatives, but the results obtained with Background X were better and in this paper we will refer to them exclusively.

Preparation of Master Negatives

The master negatives were prepared by exposing three strips of Background X film

in the Retina camera at f.8, giving a range of six exposures on each strip by varying the time. The three strips were developed in D.76d. to gamma levels of 0.64, 0.82, and 1.02.

Each frame on the three strips was inspected under a low-power microscope and note was taken of the patches in which the resolution chart showed 40 lines per mm. or better.

Figs. 5 (a) and (b) illustrate the results of this survey. In Fig. 5 (a) there are three

teristics of the lens. Fig. 5 (b) shows the same experimental results plotted on a grid relating the highlight density of the negative to the density of the foreground image on the negative. In this plot more emphasis is placed upon the luminance contrast conditions in the focal plane of the camera and the results should be less dependent upon the flare characteristics of the lens. However, in order to use this second chart it is necessary to make trial exposures and to arrive at the final working conditions after measur-

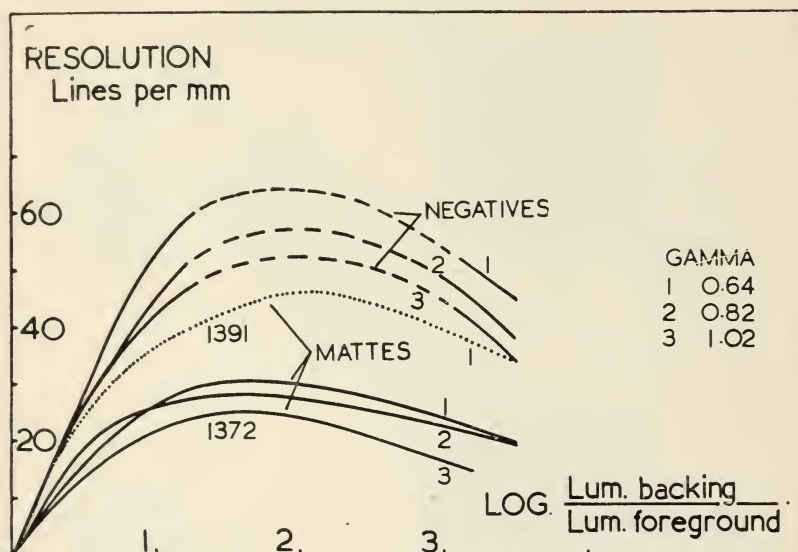


Fig. 6. The resolution of the negatives and the derived mattes are related to the contrast between foreground and backing. The fall in resolution at the highest contrast appeared to be due to clogging-up of detail as the result of image spread

zones drawn on a grid relating the maximum highlight density of the developed negative image (*i.e.*, the image of the plain backing of the foreground subject) against the luminance ratio between the foreground and the backing. At any place inside a zone it is possible to obtain a resolution of at least 40 lines per mm. in the negative image. The three zones correspond to the three processing gammas.

From this diagram it is possible for the cameraman to select the best conditions of luminance ratio between foreground and backing, and the camera exposure in order to achieve the best resolution, provided only that the same lens is used, because these results are conditioned by the flare charac-

ing the densities of backing and foreground images on the processed negatives.

THE PRINTING

In the first instance, a detailed survey was made using 1372 sound-recording stock. Later it was thought that 1391 High-Contrast Positive might give better results and this was confirmed by making tests under the conditions shown to be best by the results for 1372 film. For this reason the work with 1372 film will be described to show the pattern of the results.

Only those negative frames having at least one image patch of 40 lines per mm. or better were used for making the prints. The negative and printing stock were exposed

frame-by-frame in a pressure printing-frame to a V-filament automobile headlamp bulb at a distance of 5 feet. This approximated to a point source. A series of prints of increasing exposure was made from each negative frame.

The prints were developed for 4 minutes at 20°C. in D.172, and when the processing was completed they were dried at room temperature. Each family of prints from a given negative frame was inspected under the microscope and the print showing the best resolution was selected for use in preparing the final matte. The selected frames were printed once more on to 1372 stock using the same apparatus. This time the exposed material was reversal processed, developing for 4 minutes at 20°C. in D.172, bleaching in acid permanganate for 7 minutes at 18°C. and redeveloping in the fogging developer FD68 for 5 minutes at 18°C. When the processing had been completed in the usual way, the prints were dried at room temperature.

Resolution in Matte Lines

The mattes were selected from these reversal prints by taking those having the best resolution. Fig. 6 shows the relationship between the resolution of the 1372 mattes and the luminance separation between tones in the foreground and the backing.

The maximum resolution values reached in these mattes are:

Negative gamma	Maximum resolution in matte lines per mm.
0.64	30
0.82	25-30
1.02	25

It is seen that the mattes having the highest resolution were those from the negatives of lower gamma.

SENSITOMETRY

Having eliminated from the survey those regions of gamma and exposure, in the various stages, that gave results that were irrelevant on the score of poor resolution, the sensitometric inter-relationships between the negative, first print, and mattes could be set

out; and they are shown in Fig. 7. This shows the results derived from various negatives of processing gamma 0.64. The three negative curves correspond to different exposure levels. The negative of least exposure would probably have a tone range insufficient to accommodate a normal foreground subject, though it is included because it meets the resolution requirement.

Experience in the studio experiments showed that for completely safe masking, a matte density of 2.0 would be needed, though a lower density might be taken in special cases.

If a density of 2.0 is marked off on the characteristic curves for the mattes in Fig. 7 and is referred back to the original negative curves, then the luminance ratio between the foreground highlight and the backing required to achieve a satisfactory matte will be seen to be approximately 2.7. The luminance ratio falls to 2.0 for a matte density of 1.6. Fig. 7 also shows that the first 1372 print should be given a sufficient exposure for the minimum density to be 0.7.

Part of the work was repeated using 1391 stock for both printing stages and working from the best negative of gamma 0.64. The results are shown in Figs. 6 and 7. Using D.16 as the developer for the first print a resolution of 45 lines per mm. was reached in the matte (1372 did not show any improvement when D.16 was used). The luminance ratio between foreground highlight and backing to give a matte density of 2.0 was 2.6, *i.e.*, very nearly the same as for 1372 stock.

DIMENSIONS

The dimensions of each frame and of the image patches were measured at all stages of the work. There were found the changes to be expected from film shrinkage and image spread. The base shrinkage found was 0.10% in length and 0.14% in width. These are of the same ratio though somewhat smaller than the published figures of 0.12% for length and 0.19% for width.³

No useful purpose would be served by discussing film shrinkage as a factor affect-

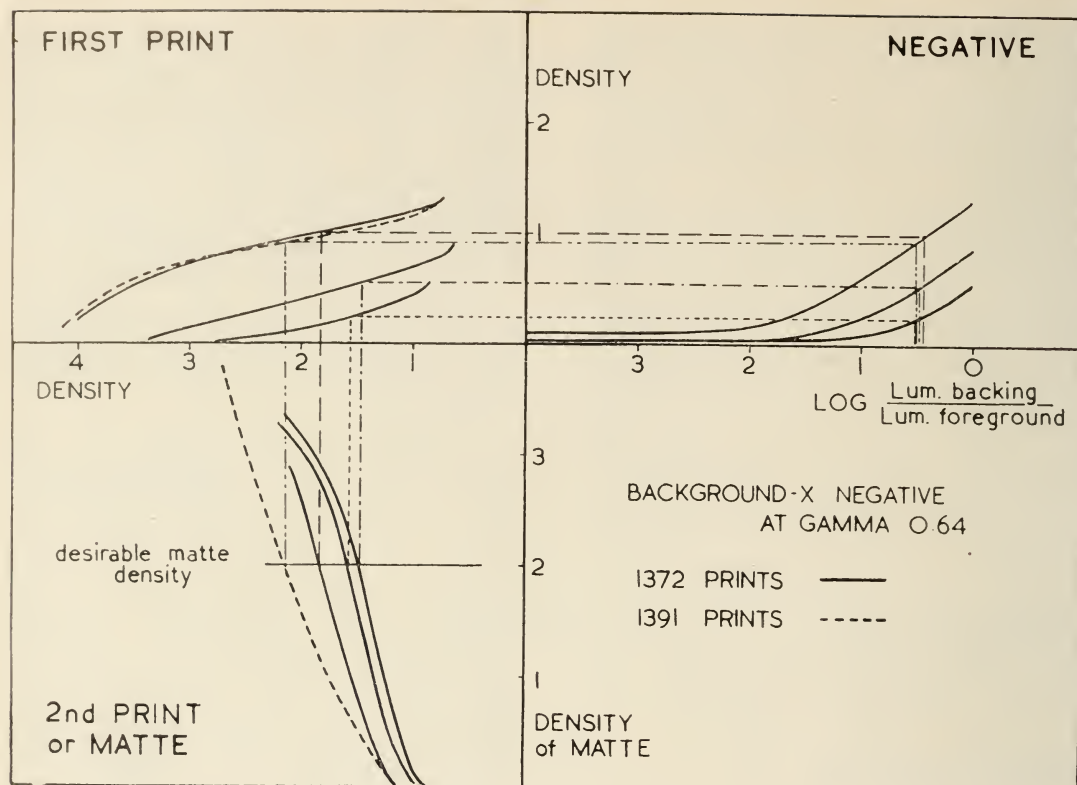


Fig. 7.

The sensitometric characteristics of negatives at three levels of exposure, first prints, and mattes. The diagram shows that matters of density 2.0 can be obtained at backing/foreground luminance ratios of between 2 and 3.

ing the dimensions of the mattes; moreover the position has been much improved by the introduction of the new safety supports. For example, the Eastman high acetyl support has almost equal shrinkage in both directions at the low level of 0.05-0.06%. This shrinkage could be almost entirely compensated by a corresponding enlargement in the optical printer.

Image Spread

The image spread is of direct importance in matte work because it depends upon the contrast between the outline of the foreground subject and the backing, and this contrast is likely to vary widely at different parts of the outline. Values for the image spread were obtained by measuring the size of the image patches on the negative and mattes. After correcting for the two shrink-

ages in the two printing stages, the size of the patches on the negatives were subtracted from the size of the corresponding patches on the mattes. Typical results for the 1372 mattes shown in Fig. 7 are seen in Fig. 8. This shows the shift of the matte boundary relative to the boundary of the patch on the negative, measured from the centre of the patch, in other words the values of shift are half the values found by taking the over-all sizes of the patch. The shift of matte outline relative to that of the negative varies with the contrast between the foreground and backing, and the range is of the order of .0006 inch, running from .0004 inch under-size to .0002 inch over-size.

No measurements were made with the 1391 mattes, but it is not thought that the dimensional characteristics would be much different from those of 1372, though any

difference would very likely be on the side of improvement because of the better resolution characteristics.

DISCUSSION

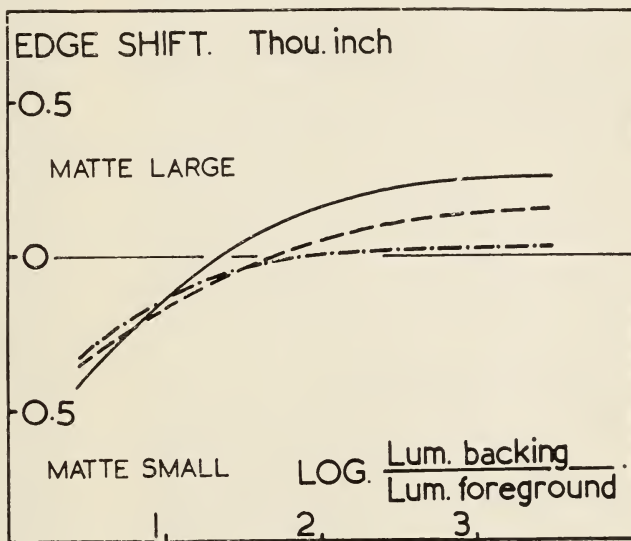
Without having the experience of carrying out the present matte process under studio conditions, it is not possible to assess the value of the figures given in the above account.

As they stand, the figures are encouraging. Mattes of a minimum density of 2.0

ance without relating them to the particular subject that it is desired to matte. The visibility of any outline on a matted subject will depend upon the tonal values of the final scene and upon the way in which the tones are broken up.

The limitations imposed upon matting by the variations in image dimensions by light spread will apply also in the case of the beam-splitter method where a colour separation is used, and are not confined to our present method. In fact, it is possible that

Fig. 8. The shift of the edge of the matte image relative to the edge of the negative image. The curves correspond, in height order, to the three negatives in Fig. 7.



can be made from foreground subjects in which the luminance of the backing is 2.6 times as great as that of the foreground high-light. If a minimum density of 1.6 is acceptable in the matte, the lighting ratio can be reduced to 2.0 times.

Using 1391 stock it is possible to obtain mattes having an outline resolution of 45 lines per mm. in regions corresponding to the "shadows" of the foreground subject.

The bare figures for changes in image dimensions do not seem high, though here again it is not possible to assess their significance

the present method may suffer less in this respect than the beam-splitter method because the reversal printing in the second stage effects some cancellation of the light-spreading that is found in the first print.

ACKNOWLEDGEMENTS

The authors are grateful to Messrs. T. W. Howard, F.B.K.S., M.G.M. British Studios, Ltd., and R. L. Houlst, M.B.K.S., A.R.P.S., J. Arthur Rank Organisation, Pinewood Studios, for many discussions during the course of this work.

REFERENCES

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A NON-REFLECTING ROOM AND ITS USES FOR ACOUSTICAL MEASUREMENT

F. H. Brittain*

SOUND is heard under a wide variety of conditions which may modify the original sound field, and, unlike a microphone, an average person is able to differentiate to quite a large extent between the source of sound and the effects of its surroundings. This is possibly due to the complex nature of the common sounds. It is much more difficult to separate out the direct sound if it is a single pure steady frequency.

The interpretation of measurements made with a microphone must therefore be carefully considered, bearing in mind the difference between the subjective perception of the sound and its objective measurement.

1. Objective Measurement

It is very difficult to separate the direct from the indirect sound by purely objective means. It is also frequently impossible to separate out the effects of surroundings on a source of sound; they may assist radiation at one frequency and reduce it at another. It becomes apparent that both the source of sound and the measuring device must be in a standard environment. This is normally taken to be free space; that is, a normal atmosphere with nothing else there. This can be approximately realised out of doors, well away from buildings and the ground as in Fig. 1 which shows a loud speaker mounted on a tower to reduce its proximity to the ground. Outdoor measurements in the British Isles have disadvantages, for it is seldom possible to obtain a dry, windless day in completely silent surroundings.

To overcome these disadvantages, attempts have been made to build rooms with non-reflecting walls, floor and ceiling.

The early "echo-free" rooms as they have come to be called were not very absorbent to the lower frequencies, below about 200 c/s. To overcome this defect, methods have been found of using absorbing materials to better advantage, for example as wedges three or more feet in thickness. This great size is necessitated by the long wavelength of low frequency sounds. The wedge form is used in order to make the change of impedance between the air and the sound absorber as gradual as possible. Fig. 2 shows a typical modern echo-free room at the Research Laboratories of the G.E.C.

In order to test the effectiveness of the treatment, a G.E.C. Laboratory Standard Condenser Microphone was set up in such a room at a distance of 1 metre from a loud-speaker. This distance was maintained for measurements at a number of different positions in the echo-free room. The measurements differed from each other by the maximum amount of only ± 1.3 db. for frequencies down to 40 c/s showing that echoes had been virtually eliminated.

2. Description of Echo-Free Room

The ceiling and end walls were treated with wedges made of "Fibreglass," each three feet in length, whereas those on the side walls and floor were two feet in length. This was done in order to obtain a clear working space of 15 ft. by 10 ft. by 9 ft. inside the room. This space has been found to be entirely adequate for our particular requirements.

The wedges have a base 8 inches by 8 inches and are held in position in the room by two grids or nets of $\frac{1}{4}$ inch steel rods spaced at 8 inch intervals so that the base of a wedge is a push fit in the mesh. In

* Research Laboratories of The General Electric Company, Limited, Wembley.

order to support the wedges in a horizontal position on the walls, two grids are provided. One is fixed 2 inches from the face of the 14 inch brick wall and the other at 9 inches from it. Fig. 3 shows the room in course of construction. The ceiling has only a single grid since there is no turning



Fig. 1.

Free field testing of a loud speaker out of doors.

moment on the wedges. No grid at all is provided for the wedges on the floor. No trouble of any kind has been experienced with the fixing methods employed but if wedges of a greater length or lower density, and hence greater fragility, are used, additional support would probably be necessary for the horizontal wedges.

3. Fittings

Some care has to be exercised in the choice of fittings if the room is to remain echo-free

at high frequencies, since the wavelength may be as small as 1 inch and reflections may be expected from any fitting whose least dimension is half an inch or more. The floor, which is transparent to sound, consists of a steel wire net, the wire being $\frac{1}{4}$ inch in diameter, spaced 2 inches apart. It is supported on $1\frac{1}{2}$ inch vertical tubes spaced at intervals of three feet. Since this room is used for a wide variety of acoustical tests, a railway track is provided to handle weights up to 5 cwt. This track is provided with a turntable which may be operated by remote control from outside, thus permitting the polar distribution of sound to be easily determined. The turntable and transparent floor may be seen in Fig. 2. They can all be removed for accurate measurements at unusually high frequencies.

Two rails near the ceiling of "Inverted T" section are provided for moving the microphone along the room or across it. This completes the fittings of the echo-free room with the exception of the door. Since the wedges on the door are three feet long, it has to be withdrawn three feet from the room on a suitably aligned track before it is possible to swing it round in the conventional manner.

Direct current is used to supply the lamps which illuminate the room to reduce the possibility of picking up mains hum when very weak noises are being measured. All objective tests are conducted from the adjoining measurement room.

4. Apparatus

A G.E.C. Laboratory Standard Condenser Microphone is used for measuring the sound. It has been in continuous use since it was first calibrated at the National Physical Laboratory in 1932 and during that period its sensitivity has changed by less than 1 db. It is fed into a battery-operated microphone amplifier located in the measurement room. An attenuator and output meter are provided and are corrected to an accuracy of ± 0.1 db. The microphone amplifier may also be fed to wide or narrow band wave analysers.

For testing microphones and loudspeakers, a beat frequency oscillator and power amplifier are used to supply steady state electrical energy to the source of sound or the loudspeaker under test.

A "noise diode," in which there is a random transit of electrons, and amplifier are used in those cases where it is desirable to use an unsteady test signal. For the



Fig. 2

Modern echo-free room showing transparent floor and turntable.

routine testing of microphones and loudspeakers, automatic equipment is provided for plotting the curve of intensity against frequency. This equipment, invaluable in the development stage of a project, is only equalised to an accuracy of ± 1 db. Subjective tests are also carried out in the echo-free room and suitable signalling apparatus is included.

5. Uses of the Echo-Free Room

Microphones are tested by measuring their electrical output when they are placed in

the sound field from a loudspeaker. The intensity of this sound field is measured by means of the Laboratory Standard Microphone for every frequency at which a measurement is required. The same procedure is followed for determining efficiency, frequency response and harmonic content, except that in the last case a knowledge of the harmonic content of the sound field is required. Unless this is small, the harmonic content of the microphone will be indeterminate, since the phase relationship between the harmonics of the field and those of the microphone output are not measured by these procedures. Polar response is measured by rotating the microphone, which is mounted for convenience on the turn-table and maintaining it in a constant sound field.

Loudspeakers are measured by mounting them on the turntable and supplying them with electrical energy at a constant voltage. The resulting sound pressure is then measured with the Laboratory Standard Microphone at a distance of either 1 or 2 metres. The harmonic content of the electrical input to the loudspeaker must of course be small. The loudspeaker should be tested in the cabinet in which it is to be used, for the latter has a profound effect upon its performance.

The sound output from a radio or television set is measured by feeding a modulated radio frequency signal to the set, and measuring the resultant sound field as before. A constant modulation depth is usually employed. In the case of a gramophone, a calibrated test record is used.

6. Noise Measurement

A large number of devices emit sound when in operation, even though silence is much to be preferred. Arc lamps, cameras, trucks, switches, fans, motors, etc., fall in this class.

The usual measurements made on these devices are the intensity of the total sound, together with its spectral distribution. An attempt is frequently made to present the results in subjective form (loudness) by weighting some frequencies more than

others. This weighting is in accordance with the behaviour of a "normal" person to a sound of that intensity. Additional corrections have to be made to the objective results in the case of impulsive sounds before they can be used to indicate loudness, for the ear tends to judge loudness by the intensity of the impulse, whereas most meters integrate energy with respect to time. They would, for example, show that the noise from a motor-cycle exhaust increased *pro-rata* with the frequency of the explosions, but most people would judge that such a

standard of loudness, but suffers from the defect that it gives rise to standing waves or similar reflection effects unless it is used either in free space or an echo-free room. Wide band or "white" noise, generated by the "noise diode" is random in character and so does not give rise to these reflection phenomena, even if it is used for loudness measurements in an ordinary room. It should be remembered, however, that the radiating properties of the loudspeaker will be modified by the acoustic properties of such a room, and so will appear to be

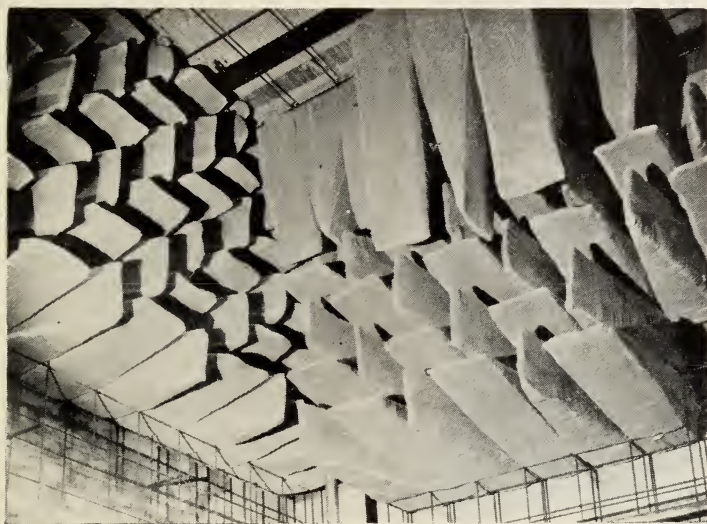


Fig. 3 Echo-free room in the course of construction.

machine is almost equally noisy over quite a wide range of engine speeds.

An echo-free room must be used for all those subjective-objective determinations which require a known sound field into which the subject may be introduced. Such tests include the determination of the free field threshold of hearing. This has been found to differ appreciably from the previous values obtained when telephones were used, because the latter methods make no allowance for diffraction of the sound round the observer's head. It can also be used for the determination of the relative loudness of wide band noise and a 1,000 c/s note. The 1,000 c/s note is accepted as a reference

slightly different from those measured in an echo-free room.

7. Conclusion

The results of measurements obtained in an echo-free room must always be linked with subjective listening under appropriate conditions. It is much easier to make measurements than to understand them. Where correlation between subjective and objective results is not apparent, consideration must be given to whether the presentation of the objective results imparts the correct result to the mind, and whether the subjective and objective conditions of test are strictly comparable. For example, the response of the ear to weak sounds is very

much less for low frequencies than it is for the middle and upper register, but when the sounds are strong this is no longer the case, the response of the ear is roughly the same for all frequencies.

A loudspeaker may have a response curve which by objective measurement is "perfect," *i.e.*, its intensity does not vary with frequency, but if it is heard at the wrong loudness level it will sound as if it is giving very imperfect reproduction. If the level is too high then the bass will sound much too loud. Measurements have shown that

people tend to set domestic loudspeakers at too high a level.

Second order subjective effects may also easily become of primary importance when measured objectively, and vice versa. Thus a listener is capable of concentrating on the source of sound and discounting the reflected sound. A microphone, however, has not the capacity to differentiate in this way, and so it becomes necessary to install special acoustical treatment in studios where microphones are used, and to construct echo-free rooms for measurement purposes in which they are involved.

THE TELE-KINE GROUP

In conjunction with the Television Society, the B.K.S. has arranged two courses of study, consisting of four lectures each, on television in the kinema.


The courses will commence in the New Year and details will be announced later. The enrolment fee will be 15s. for members of either Society and 25s. for non-members.

SENSITOMETRY

A course of six lectures on Sensitometry will commence at the Colonial Film Unit Theatre, 21 Soho Square, W.1, on Monday, January 21, 1952.

The Lecturer will be Mr. I. B. M. Lomas, M.B.K.S., A.R.P.S., and the enrolment fee will be one guinea for members of the Society and two guineas for non-members.

N.B.—The enrolment forms and syllabuses for the courses will be inserted in the December issue of the Journal.



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THE COUNCIL

Summary of the meeting held on Wednesday, October 3rd, 1951, at 117, Piccadilly, W. 1.

Present: Mr. H. S. Hind (*Deputy Vice-President*) in the Chair, and Messrs. R. J. T. Brown (*Hon. Secretary*), N. Leever (*Hon. Treasurer*), D. F. Cantlay, F. G. Gunn, F. S. Hawkins, R. E. Pulman and S. A. Stevens.

In attendance: Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from the President, the Vice-President and the Past President.

Projectionists' Training Scheme.—An Apprenticeship Scheme Committee has been appointed to prepare the training syllabus. The C.E.A., the N.A.T.K.E. and the Ministry of Education have been invited to appoint representatives to serve on the Committee.

COMMITTEE REPORTS

Membership Committee.—The following are elected: Donald Kirby Blagbrough (Associate), Gaumont Cinema, Hendon, N.W.4; John Richard Cope (Associate), Philips Electrical, Ltd., Century House, Shaftesbury Avenue, W.C.2; Yeshwani Damodar Sarpotdar (Member), Minerva Movietone, Siwri, Bundar Road, Bombay, India; Mahinder Nath Malhotra (Member), Minerva Movietone, Siwri, Bundar Road, Bombay, India; Frank Robert King (Member), Kay Printing Co., Ltd., 22, Soho Square, W.1; and Beric Wadham Knight-Simpson (Member), Public Relations Department, Government of Nigeria, Lagos, B.W.A.

The death of Robert Alfred Allman was noted with regret.—*Report received and adopted.*

Tele-Kine Group.—The first course of four lectures on television in the kinema will commence in January, 1952. The enrolment fee for members of the B.K.S. and the Television Society will be 15s. and for non-members 25s.

Education Committee.—Arrangements have been completed for the course on Kine Camera Technique, commencing at Ealing Studios on October 15, 1951.

The course on Sensitometry will commence at the Colonial Film Unit on January 21, 1952.—*Report received and adopted.*

The proceedings then terminated.

SUBSCRIPTION RATE FOR 1952

The Publications Committee is reluctantly compelled to revise the subscription rate of "British Kinematography" to meet increasing production costs.

From January, 1952, the annual subscription rate will be:—

12 monthly issues £2 17s. 6d.

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THE ECONOMICS OF FILM PRODUCTION

With the apologies of W. Vinten, Ltd., your attention is drawn to Fig. 5 contained on page 113 in the October issue. The caption should read: "The Vinten Power Operated Run Truck in use for a T.V. Production."



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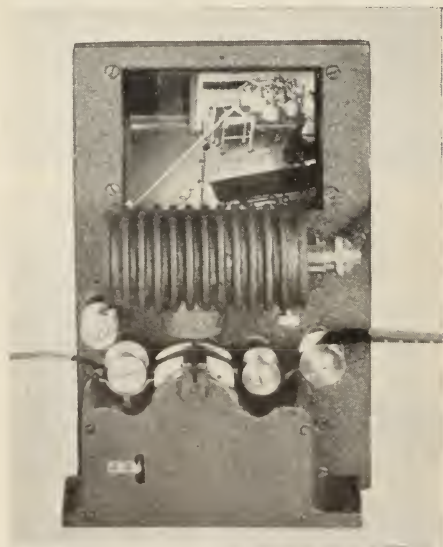
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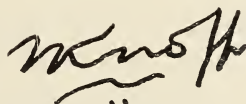
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MESSAGE FROM THE PRESIDENT

It has been a great disappointment to me that through ill-health I have been unable to join in the Society's activities for the past few months. However, after a short convalescence abroad, I am hoping to return with renewed vigour.

In the meantime, I send you sincere good wishes for Christmas and a successful year in 1952.



117 PICCADILLY

Once more our Society is faced with the problem of changing the address of its Headquarters. The Carnegie Trust has informed us that we must vacate our present offices by March 31, 1952.

Each move since we left Dean Street has taken us a little further from the centre of the British film industry—Wardour Street. Ideally, our offices need to be near the centre of this district,

so that the B.K.S. becomes a convenient port of call and so that our technical library, reference books and up-to-date periodicals are easily available to members.

If any reader knows of suitable office accommodation, our Secretary will be most grateful to hear of it.

R. J. T. BROWN, Hon. Secretary.

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LECTURE PROGRAMME — SPRING 1952

Meetings to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W. 1, commencing at 7.15 p.m. The Sunday Meeting on February 10th will commence at 11 a.m. Meetings of the 16mm. Film Division are held in the G.B. Small Theatre.

SOCIETY MEETINGS

- January 2 ... "Filming Radar," by JOHN R. F. STEWART, M.B.K.S., A.R.P.S.
- February 6 ... "The Use of the Training Film by the E.C.A.," by R. KING, M.B.E., M.B.K.S.
- March 5 ... "Problems of Storing Film for Archive Purposes," by HAROLD G. BROWN.
(Joint Meeting with the British Film Academy.)
- April 2 ... "A New Television Recording Camera," by W. D. KEMP, B.Sc., A.M.I.E.E.
(Joint Meeting with the Television Society.)

16mm. FILM DIVISION

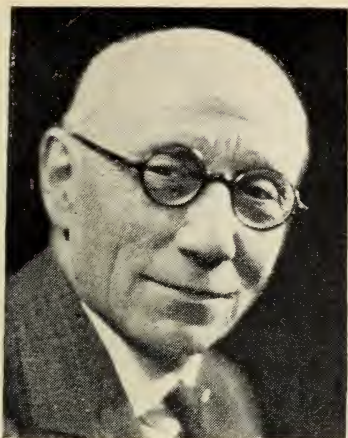
- January 9 ... "The Film in Medicine," by YULE BOGUE, Ph.D., M.R.C.V.S.
- March 12 ... "U.S. Joint Army and Navy 16mm. Projector Specification,"
by G. M. WOOLLER-JENNINGS.

THEATRE DIVISION

- February 10 ... "Westinghouse Cinema Arc Rectifiers," by S. A. STEVENS, M.I.E.E., M.B.K.S.
- April 8 ... Lecture to be announced.

FILM PRODUCTION DIVISION

- January 16 ... "Magnetic Recording: A Progress Report," by W. H. CLARKE, O.B.E.
- February 20 ... "High Definition Films," by NORMAN COLLINS.
- March 19 ... "High Definition Film Technique," by T. C. MACNAMARA, A.M.I.E.E.



WILLIAM GEORGE BARKER

HON. F.B.K.S.

The death of William George Barker, Hon. F.B.K.S., on November 6th, 1951, is announced with profound regret.

AN APPRECIATION

THE passing of Will Barker takes from us one of the greatest personalities of the early days of British film production. Starting as an amateur in 1896, when he bought a Lumière camera, he turned professional in 1901, when he founded the Autoscope Company. For some years he specialised in topicals and also in "staged" subjects, which were made on an open air stage at Stamford Hill, utilising scenery borrowed from the Stoke Newington Theatre. In 1906, the Autoscope Company was amalgamated with the Warwick Trading Company, with Will Barker as Managing Director. The number of films "published" annually was rarely less than three or four hundred, including a large number of foreign films for which Warwick was selling agent.

In 1908 he formed his own company, Barker Motion Picture Photography Limited, with studios and laboratories at Ealing Green and additional laboratories and offices at 1, Soho Square. It was at this period that (as recorded by Miss Rachael Low, the film historian) the immense force of his personality and the scale and daring of his conceptions formed the core of a company which seemed always to be hurling itself against new and impossible obstacles. He engaged Sir Herbert Tree, Violet Vanbrugh and Arthur Bouchier to play in his first major

film, "Henry VIII," and this was followed by "East Lynne," "Jane Shore," "Brigadier Gerard," "Sixty Years a Queen" and other historic films, made on the three electrically lit glasshouse stages at Ealing. When not revelling in big crowd scenes and grandiose scenery, he turned out a steady flow of melodramas such as "London by Night," "By the Shortest of Heads," "Lights of London," "In the Hands of London Crooks," "Humanity" (with John Lawson) and "As a Man Soweth." In these films the melodramatic stories were partly played in actual London settings, in the docks, at railway stations or on the Embankment, thus imparting a sense of realism not often seen on the screen in those days.

Will Barker retired from the film industry in 1921 and ran the Roll Film Company at Wimbledon, which processed and printed amateur snapshot films. He retained his interest in the film industry, however, particularly on the technical side, and has been a member of the B.K.S. for 13 years, being made an Honorary Fellow in 1949. He was also a member of the Cinema Veterans (1903). The chain of office worn by the President of the British Kinematograph Society was the gift of Will Barker in memory of the late President, Capt. A. G. D. West.

BAYNHAM HONRI

PAINTED MATTE SHOTS

E. Hague (Member)

Read to a meeting of the Film Production Division on October 17, 1951

DURING the last ten years there has been a progressive appreciation of the possibilities of Painted Matte Shots. Producers and Art Directors are now beginning to exploit these possibilities instead of using matte shots solely for providing ceilings or for topping up sets which are too large for the stages in which they are built.

If the technique employed in making matte shots is more fully understood by those people who plan a picture, then it is quite possible that they may see further ways in which the process can be utilised, and the intelligent use of matte shots can be a considerable factor in the lowering of production costs. My experience in painted matte shots is limited to those films that have been photographed in colour by Technicolor. The following list shows how many painted matte shots have been used on colour feature pictures made in England during the past ten years:

" Henry V "	8
" The Life and Death of Colonel Blimp "	8
" This Happy Breed "	2
" Men of Two Worlds "	6
" A Matter of Life and Death "	9
" Black Narcissus "	14
" The Red Shoes "	14
" An Ideal Husband "	19
" Scott of the Antarctic "	5
" Bonnie Prince Charlie "	38
" Gone to Earth "	10
" Treasure Island "	20
" Pandora and the Flying Dutchman "	8
" The Black Rose "	27
" Captain Horatio Hornblower, R.N. "	19
" The Tales of Hoffmann "	5
" Robin Hood "	35

The following is my definition of the term: A painted matte shot is produced when a part of the frame of the original photograph is matted out or obscured, and then, at a later date, a second exposure to a painting is made, which fills in that area that has not yet received an exposure.

Method of Making

In general there are two methods of making painted matte shots: the first method is by

double exposure on to original negative, and the second is by duping part of the original negative and double exposing on to the dupe.

Between 1937 and 1946, Mr. Percy Day produced many very successful painted matte shots in Technicolor on such films as " The Drum," " The Four Feathers," " Thief of Baghdad " and " Cæsar and Cleopatra," by using a method of double exposing on to the original negative.

The disadvantages of this method were, however, that the Director had no check on whether the action was correct in the chosen take until several weeks later, and during this period the differential latent image build-up or fall-off on the three records made it extremely difficult to match the colours of the painting to those of the original scene.

Double Exposing of Dupe Negative

As a result of this, it was decided in 1946, when making " Black Narcissus," to attempt to make matte shots by double exposing a dupe negative. After a lot of painstaking work in collaboration with Mr. Day and Mr. Veevers, of British Lion Film Studios, and Mr. Ellenshaw, a method of making dupe matte shots which is fairly simple, and in the majority of cases very successful, has been produced.

With dupe matte shots it is not necessary to use mattes in front of the camera to obscure the unwanted parts of the picture during the original photography, as this is done at a later stage of processing.

The camera should be securely jacked and tied down, but this is practically the only precaution that need be taken, as in every other respect the first exposure of a matte shot is the same as an ordinary production shot. No special test footage has to be photographed; the negative is developed immediately after exposure, and only negative clippings and a colour pilot are sent to the Matte Shot Studio.

Practical Example

As an example of making dupe matte shots, Fig. 1 shows a model matte shot set-up ; this is how a scene for "Treasure Island" was produced. The Art Director was Tom Morahan and the Matte Artist Peter Ellenshaw.

Fig. 2 shows a print of the original photography and Fig. 3 a print of the completed matte shot as it was used in the film.

This shot was designed as a matte shot, and the set-up was chosen so that the ship

The next stage was to prepare a painting on to a sheet of glass mounted in a wooden frame of those parts of the picture that were to be replaced in order to produce the final picture visualised by the Art Director.

A standard size of photographing an area 34 ins. by 25 ins., which is a 40 times magnification of a kine frame, had been adopted ; this has the convenient ratio that one millimetre on the painting corresponds to one thousandth of an inch on a kine frame.

A smooth coating of white distemper was

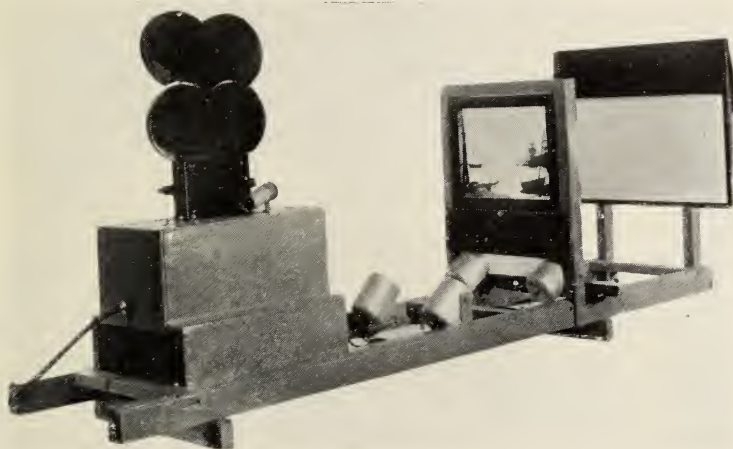


Fig. 1 — Model matte shot set-up

and the water were in the desired part of the frame as indicated in Mr. Morahan's drawing.

After a print from the original photography had been approved for action, a 10 ins. by 8 ins. enlargement was made on to bromide paper in order to allow the Art Director and the Matte Artist to decide the position of the matte line, and whether it would be a soft-edge matte or a hard-edge matte. If the join is to run along a certain architectural feature in the finished picture, then it is usual to use a hard-edge matte ; but if the join has to pass across a uniform surface, such as the sky or a smooth, flat wall, then a soft-edge matte is used to minimise the difficulty of matching tone and colour.

In this case it was decided to use a hard-edge matte, as the join would run along the silhouetted edges of the ships.

sprayed on to the front surface of the glass, which was then taken into a dark room and placed on a table under a vertical enlarger. A frame of the test negative was placed in the enlarger and the image projected at forty times magnification on to the white painted sheet of glass, to allow the Artist to pencil in all the principal features of the original scene, e.g. the horizon and the outlines of the ship.

When the desired area of painting had been completed the white distemper on the remaining parts was removed, leaving clear glass in those areas where the original picture was to be retained.

The painting, as it was finished ready for photography, is shown in Fig. 4.

The painting was then placed in front of the camera in an iron frame fitted with screw adjustments to enable it to be moved horizon-



Fig. 2 — Print of the original photography

tally and vertically, and which had a set of scales to allow the position to be noted, thereby allowing the painting to be replaced in the correct position.

The camera set-up was carefully designed to permit the camera crew to work with a smooth routine when exposing and developing the numerous tests necessary for match-

ing the two components of the picture on the three Technicolor negatives.

The camera, a black and white Mitchell camera fitted with a bipack magazine, was mounted rigidly on a reinforced concrete pillar set in the floor, with the driving motor on a separate table, and connected to the camera by a universally jointed shaft, incor-



Fig. 3 — Print of the completed matte shot

porating a safety slip clutch. A three-phase motor was geared down to turn the camera through a stop-motion unit at a range of speeds varying above and below two pictures a second. The camera and driving gear were mounted in a small room, on one side of which was a small trap-door, through which the camera lens was directed at the paintings. The camera room could then be darkened so that small pieces of exposed film could be taken out of the magazine and then carried into an adjacent dark room containing a sink with running water, where the tests were

scene and a roll of unexposed Background X. These two films were threaded up in the camera to allow the master to be passed through the camera gate in front of the raw stock on which the composite dupe negative was going to be produced.

Making the Dupe

When making the dupe there were no front lights on the painting, which was set up a few feet in front of an evenly lit white board, thereby giving a complete silhouette of the painted area. The lens was focussed on to



Fig. 4 — The painting

developed and printed. Fig. 5 shows a plan of a well-designed matte shot department.

While the painting was being prepared, special optical masters had been ordered from the original red, green and blue negatives, so that the camera could be used for printing a dupe negative of that part of the frame to be retained in the picture. After this had been done, the camera was used to photograph the painting into the area that had not been duped.

The green record was first exposed by placing a tricolour green filter in front of the lens, and a bipack magazine was loaded with the master from the green record of the original

the painting. The white board acted as an illuminant for printing the master on to the dupe negative and the painting as a matte, and preventing the master being printed into those areas that were to be replaced by the painting.

The master was taken out of the camera, and the raw stock rewound back to the beginning ready for the second exposure.

The lights on the backing were switched off, a black blind pulled down over the white backing, the front lights switched on to the painting. The camera was then turned over to expose the painting, through a green filter,

into those areas that had been matted out during the previous exposure.

The red and blue records were similarly exposed, using the masters from the red and blue negative and the appropriate tricolour filters.

A colour print was made from these composite dupe negatives.

Soft-edge Matte

If a soft-edge matte is required, this is obtained by placing a white card of the required shape in an out-of-focus position approximately twelve inches in front of the lens. A black velvet is hung in front of the painting and the white card illuminated for printing through the required area of the master. The master is then taken out of the camera and the raw stock rewound ready for the second exposure. The black velvet is taken away, the lights switched on to the painting, and the lights switched off from the white card which acts as a soft-edge matte when photographing the painting.

When setting-up for making dupe matte shots it is necessary to balance the exposure ratio of the three records by mounting neutral densities with the tricolour filters. These neutral densities are adjusted until the same densities are obtained on all three dupe negatives, when they are then exposed under identical conditions either to the white backing or to a white card placed on the painting. The three dupe negatives are exposed so that they each produce the desired gamma when exposed to an H & D chart through the appropriate tricolour filter.

The three raw stock records are all placed emulsion facing the lens. It has been agreed that the red record given by this method can be spliced celluloid to celluloid with the normal red record negative exposed in a Technicolor camera; this, as is known, is reversed left to right as a result of being exposed to a reflected image from the beam-splitter. Special optical masters with a reversed left to right red record are used for this work so that the emulsions of the masters and the raw stock can be in contact during the printing operation. These masters are made to a special contrast determined from

tests made on the camera set-up and evaluated by Technicolor.

Exposure of the Dupes

The exposure of the dupes is controlled by adjusting the lens iris to a scale setting suggested by Technicolor, who check the densities of the masters before they are delivered. The dupes are developed by Technicolor and this liaison of control ensures that the dupes have an acceptable density and quality.

The painting is exposed at the same lens iris setting used for printing the dupes and

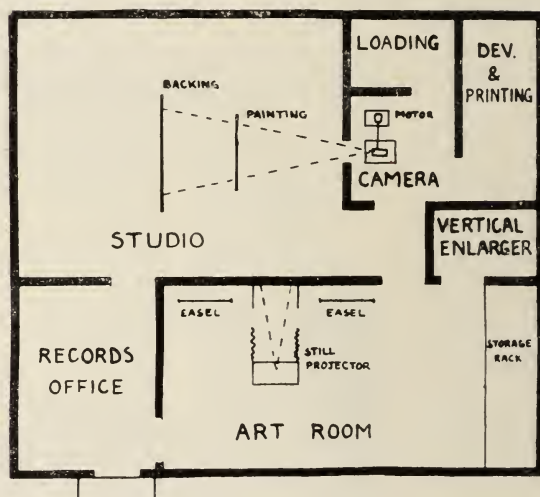


Fig. 5

Plan of well-designed matte shot department

the exposure is controlled by adjusting the opening of the camera shutter until the density on the painting negative matches that of the duped part of the frame.

Most matte shot studios have now adopted the suggestion of matching the tones and colours of the two parts of the composite picture by using a method of additive colour projection. Black and white prints made from hand developed tests of the dupe negatives are placed in three film-strip projectors fitted with their respective tricolour filters, and the three coloured images are projected in register on to a small white screen (Fig. 6). The relative intensities of the three projectors are then varied until a satisfactory colour balance is obtained on the duped part of the scene.

If the dupe negatives from which these tests were made had received a constant exposure on every frame of the duped part of the scene and if the painting was exposed frame by frame to increasing exposure levels, similar to a cinex strip, then it is possible to move the positive strips up or down in the three projectors until a satisfactory balance is obtained across the frame of the projected synthetic coloured picture.

This is a quick and simple method of establishing the relative exposure required by the painting, and a complete colour test can be made in approximately one hour, whereas it

The cost depends upon the difficulties ; the average cost of each matte shot on " Treasure Island " worked out at less than £250.

This method of making matte shots has many advantages, the most useful feature being that the original negative is developed and printed in the normal way, the best take can be chosen, and the editor can use this action print for cutting whilst the matte department are making the composite dupe.

Another useful point is that the position of the matte line can be chosen after careful consideration by the artist and the art director ; this can be altered if new conceptions of

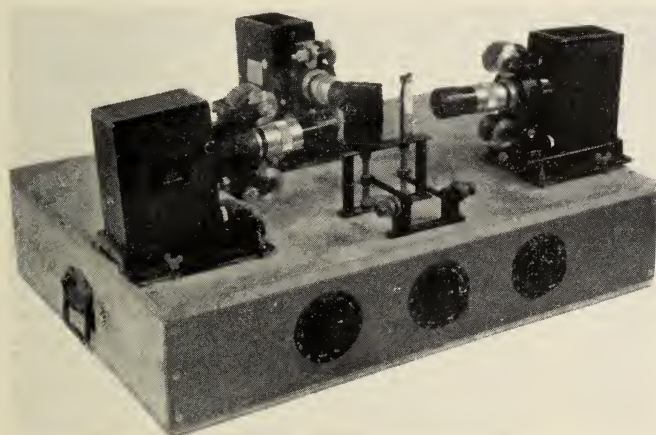


Fig. 6

Three film-strip projectors fitted with their respective tricolour filters for use in matching tones and colours of the two parts of the composite picture.

would take very much longer to obtain a colour print if the test negative was developed and printed by the normal processing methods.

Cost of Mattes

The average time for completing a dupe matte shot is from two to three weeks. It usually takes just over a week to complete the painting, and another week is needed for photographic tests and for modifying the painting to make a satisfactory join.

On " Treasure Island " we completed twenty matte shots in twenty weeks as the necessary tests could be fitted in without delay when a number of matte shots were in progress at the same time. The average cost is naturally higher if only two or three matte shots are made for each picture as the work may spread over six to eight weeks.

the composite picture are introduced while the painting is in progress.

Several attempts or alternatives can be made with each shot, as with dupe matte shots the original negative is not being worked upon, and there is no longer the responsibility of knowing that a mistake in making the second exposure might ruin a shot costing thousands of pounds and which cannot be retaken.

Modifications of Process

The process outlined can be modified for special requirements. For example, a series of paintings can dissolve to each other in the matted area, or the matted area itself can dissolve in during the scene.

Models or real objects such as foliage or bushes can be used instead of paintings, but

these have to be static objects, or the movement has to be carefully controlled to enable it to be capable of exact repetition for the consecutive exposures to the three negatives.

It is also possible to take any scene, provided that the camera was static during the first exposure, and to treat this with the dupe matte technique, to improve or modify the composition, or to remove any unwanted feature from the picture.

In this paper I have covered the basic requirements necessary to produce painted matte shots in Technicolor, and a simplified form of the same procedure can be applied to black and white films.

The process has been evolved as a result of suggestions and improvements made over a

number of years, and the working procedure is so flexible that most matte shots can now be scheduled with confidence of attaining reasonable technical perfection.

Mr. Ellenshaw then described how he was asked to set-up a studio in order to produce the matte shots that were required for "Robin Hood." The preparation and building of the necessary equipment was completed in six weeks. Although only twenty-five matte shots were originally contemplated, this number was increased to forty which were completed in the total time of twenty-five weeks. Mr. Ellenshaw demonstrated with slides and films the various effects that he had produced with painted matte shots for "Robin Hood."

DISCUSSION

A VISITOR: Mr. Ellenshaw mentioned that he made people at the back appear to move and that they were not really moving. Can he tell us how he did that?

P. ELLENSHAW: Usually the best way, and the way I used here, was a revolving disc. In this particular technique, we shoot it all in black and white so as not to tie up a Technicolor camera. I first make some holes in the painting in the area where the people are supposed to be moving. The disc is then put behind the painting and rotated until the speed of the disc and the combination of the size of hole in the painting and the sizes of dots on the disc give the impression of people moving. We then photograph a black and white master of this rotating disc, which is then printed on to the dupe negative through the holes in the painting. It sounds a little complicated, but it is only too simple if you get the speed right.

G. W. KELLY: Would it be difficult to put moving clouds in, without resorting to the automatic head or the recording movement, as things are at present, in a fairly long scene?

P. ELLENSHAW: You can put moving clouds in. Probably the best way would be to have a master of moving clouds and print that into your painting in the same way as you do the original scene. I think that normally if you paint clouds the right way, you feel they are moving, but you don't want to paint clouds that move fast, or you will feel they do not move when you see them on the screen.

M. RAYMONT: Could Mr. Ellenshaw tell us whether he has any particular difficulty with any pigments—any one pigment in preference to another? The point I have in mind particularly

is that you often come across much reflected light from the leaves of trees—and whether you find difficulty in getting the same amount of reflected gleam on painting, or whether you get drabness.

P. ELLENSHAW: We have found that with the normal range of pigments in paint—in oil colour, not in water colour—we can reproduce any colour that the camera can. There is no difficulty, because we can get it as light as the camera, and, therefore, when we put the lights on, we get the same result that you would if you went outside—if you pick the right colours, and keep the range of tones very wide. We try to keep a restricted palette, because it has been found that the more colours you use, the more garish and horrible the painting looks. But if you keep a small range, and go the full range of that restricted palette, you will be able to reproduce anything, if you know how.

R. S. ST. LOCKE: Years ago we used to make mattes. We did them on photographic plates, plates that were sensitised, and then bleached out, and painted on top of that. Is there any reason why the distempered surface is used in preference to the bleached-out photographic plate?

P. ELLENSHAW: Doug. Hague has used this process on "Treasure Island." We found it worked very well with soft edge mattes for certain scenes, where there was a lot of complicated detail that was rather difficult to draw in. In normal shots the join is not so complicated that it cannot be drawn out in less than half an hour, and as it takes much longer than this to sensitise a plate of this size, it is not often worth while making a photographic reproduction.

COLOUR CINEMATOGRAPHY AND THE HUMAN EYE

R. W. G. Hunt, B.Sc., A.R.C.S., D.I.C.*

Read to a meeting of the British Kinematograph Society on November 7, 1951

THE photographic camera has often been said to be similar to the human eye. Both consist of a light-tight chamber in which an image of part of the outside scene is formed by a lens on a light-sensitive surface, and both control the intensity of this image by an iris diaphragm. Similarly the modern three-layer colour film may be said to be similar to the retina of the eye, in that both record all colours in terms of three variables only. But the similarities are confined to a few broad principles only, and the differences between colour film and the retina are numerous and important.

If the colour film "saw" colour in exactly the same way as the eye, it would be expected to reproduce all the colours in any scene so that they appeared to be of exactly the same hue, saturation, and lightness as the originals. Patches of colour have only to be recorded on colour film and the results compared side by side with the originals to see that large discrepancies occur. It is the purpose of this paper to discuss two main questions. Firstly, why do these discrepancies occur? Secondly, how important are they in practice?

THE CAUSES OF INCORRECT COLOUR REPRODUCTION

Our knowledge of the way in which the retina responds to light of different colours is in many ways incomplete. But it is generally agreed that there must be three different types of receptor: one type mainly sensitive to orange and red light, another mainly sensitive to green light, and a third mainly sensitive to blue light. Moreover, from various experiments on colour matching,¹ the spectral sensitivity curves of these three types of receptors are known approximately and are as shown in Fig. 1, the three sensitivities, β , γ , and ρ being plotted against wavelength. When light of any colour falls on the retina, the different sensitivity curves of the three

receptors will result in three signals, β , γ , and ρ being sent to the brain, and if, for instance, the ρ signal is larger than the other two signals, then a reddish sensation will be experienced; if the γ signal is the largest, then the sensation will be greenish, and so on.

If, now, the three layers of the colour film had sensitivity curves closely matching those of the eye, then it might be thought that correct colour reproduction must necessarily result. But three layers of photographic emulsion are only capable in themselves of producing black-and-white images; the colour has to be put into the system elsewhere. The simplest way, from the theoretical standpoint, of doing this is to strip the three black-and-white negative images apart,* print (with perfect tone reproduction) black-and-white positive transparencies from them, and insert them in three separate projectors, one of which is fitted with a blue filter, another with a green filter, and the third with a red filter. If the red filter were chosen so that the light transmitted by it affected only the ρ -receptors of the eye, the green filter only the γ -receptors, and the blue filter only the β -receptors, then on superimposing the three images on a screen exact colour reproduction would result. For instead of the colours of the original scene producing their appropriate ρ , γ , and β signals, they have produced areas of photographic density on the positives in the projectors such that at each point the transmission is proportional to the ρ , γ , or β signal, as the case may be. Hence light from the red lantern produces the correct ρ signal at each point in the picture, that from the green lantern the correct γ signal, and that from the blue lantern the correct β signal, and hence the eye

* It is interesting to note that a practicable method of doing this has recently been developed (see Reference 8).

* Research Laboratories, Kodak Limited, Harrow, Middlesex.

receives the same signals ρ , γ , and β from the reproduction as it would have done from the original.

In order for the above state of affairs to obtain, it is essential that:

- the three layers of our film should have the sensitivity curves, β , γ , and ρ ;
- perfect tone reproduction be achieved in our positives, and
- the blue, green, and red filters in our three projectors be such that they stimulate respectively only the β -receptors, only the γ -receptors, and only the ρ -receptors of the eye.

Unfortunately, this last condition is impossible to achieve. If reference is again made to the curves of Fig. 1, the reason will be obvious. Even if light of monochromatic purity is used in our three lanterns, it is only possible for the red lantern to meet the requirement. It is seen that light of wavelength R , 6500A (or any longer wavelength), stimulates neither the γ - nor the β -receptors, but only the ρ -receptors. Light of wavelength B , 4400A, is seen to stimulate chiefly the β -receptors, but unfortunately the ρ - and γ -receptors are slightly stimulated in addition. When a search is made for a wavelength of light which stimulates only the γ -receptors, none can be found which does so even approximately. The best that can be done is to choose the wavelength G , 5050A, which stimulates the γ -receptors strongly, and the ρ - and β -receptors to almost the same extent.

If, then, using the sensitivity curves of Fig. 1 for the three layers of the film, the three transparencies are projected in lanterns filtered to give the monochromatic radiations, R , G and B , how would the reproduction differ from the original? Any portion of the picture which was before reproduced by only red light, would still be correct, of course, for the red projector meets the requirement. But wherever the green projector was shining, there would be an unwanted excess of ρ - and β -signals, and wherever the blue projector was shining there would be an unwanted excess of ρ - and γ -signals. Thus, in general, the three signals in any part of the picture will now be more nearly equal to one

another than before, and this means that the colours will be less saturated than they should be, and also that changes in hue and brightness will occur.

But triple projection with monochromatic light is not a commercially practicable method of colour reproduction, and, while no additive method of colour cinematography has yet met with much commercial success, there has recently been a renewed interest in the lenticular method of projection.² If the strips of red, green, and blue filter fitted to the projection lens transmitted only very narrow

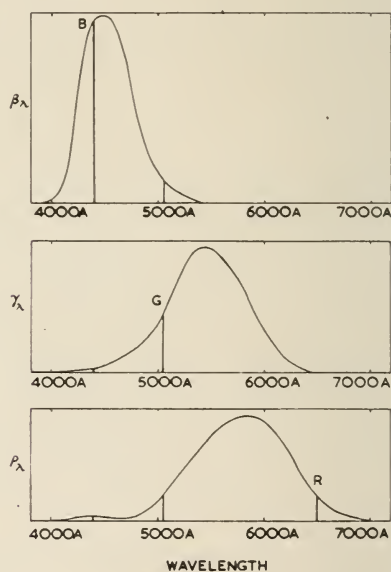


Fig. 1 — The approximate spectral sensitivity curves of the three different retinal receptors required by the trichromatic theory of colour vision.

bands of light, the desaturation of colours would not be much worse than with the monochromatic radiations. But one of the principle difficulties with the lenticular process is that the filters over the projection lens result in a considerable loss of light, and, in order to minimise this, filters transmitting broad bands of light have to be used. This means, of course, that the unwanted ρ and β signals given rise to by the green filter will be larger, as will also the unwanted ρ and γ signals given rise to by the blue filter.

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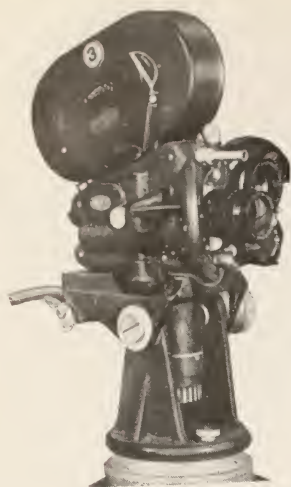
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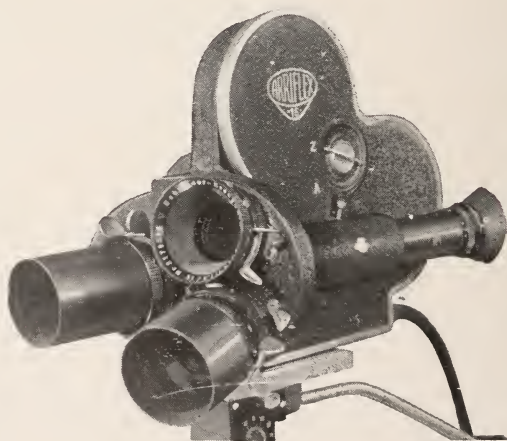
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Furthermore, even the red filter will give rise to some γ signal, in addition to the required ρ signal. So the result will be that the desaturation will be worse than in the case of monochromatic radiations.

At the present time the majority of modern processes of colour photography do not use the additive method at all, but the more convenient subtractive method. Fundamentally, however, both methods depend on the same principle.

Subtractive Method

In Fig. 2 are shown transmission curves of three so-called "ideal subtractive dyes." The cyan dye absorbs light only in the orange

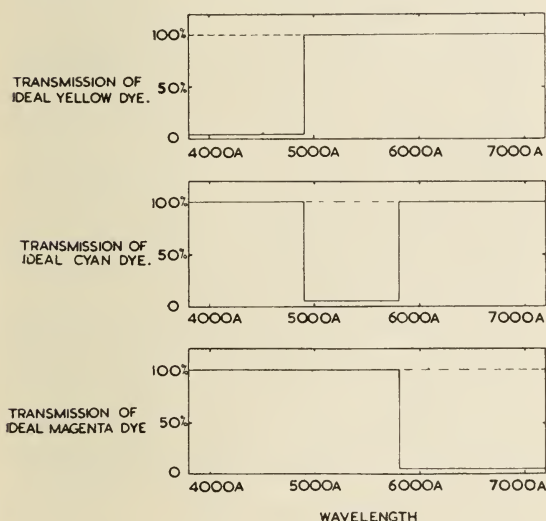


Fig. 2—The spectral transmission curves of theoretically ideal cyan, magenta, and yellow dyes.

and red parts of the spectrum, the magenta dye only in the green part, and the yellow dye only in the blue part. By varying the concentrations of these dyes the amount of light in each of the three blocks of wavelengths (marked R , G , and B) is varied. If, then, the colour photograph consists, as is usual, of a cyan dye-image, a magenta dye-image, and a yellow dye-image superimposed, assuming that we are using these ideal dyes, the colour of the reproduction may be regarded as an additive mixture of light of the

three blocks of wavelengths, R , G , and B . It is clear that the use of these blocks of wavelengths, rather than the monochromatic radiations used previously, will result in still further departures from correct colour reproduction. For the areas marked R , G , and B in Fig. 3 show the size of the signals to which the three blocks of wavelengths give rise respectively. It is seen that the red block gives rise not only to a ρ -signal but also to a considerable γ -signal. Similarly the green block gives rise to considerable ρ - and β -signals as well as the required γ -signal, and the blue block gives rise to considerable γ - and ρ -signals as well as the required β -signal. Hence, using the subtractive process, even with ideal dyes, there will be considerable desaturation of colours in the reproduction, and also errors of hue and lightness.

Of course, the ideal dyes of Fig. 2 are not available in practice, and the transmission curves of a set of dyes typical of those that have to be used are shown in Fig. 4. It is seen that they do not absorb uniformly over the blocks of wavelengths where they are supposed to absorb, and that they do not transmit 100 per cent. of the light in the other regions of the spectrum. These differences will, of course, add further to the already considerable errors in saturation, hue, and lightness inherent in the system.

It has been assumed all along that the three photographic layers have had the sensitivities β , γ , and ρ of Fig. 1, but in practice this condition is also not usually met. This is not because it cannot be met; by choosing suitable sensitizers and filter layers it can be well enough approximated to; but in view of the large number of errors inherent in the system it is generally considered advisable to use sensitivity curves more widely separated than those of Fig. 1, and a set typical of those used is shown in Fig. 5 together with the curves of Fig. 1 for comparison. The use of such a set results in some increases in the saturation of the colours, which helps to counteract the desaturating effect described above, but it may also result in additional errors in hue and lightness.

THE UNIMPORTANCE OF CORRECT COLOUR REPRODUCTION

We have seen that the departures from exact colour reproduction inherent in colour photography are of a fundamental and more or less incurable nature. It is necessary, therefore, to consider how important such departures are in practice, and in particular whether errors in some directions are more important than those in others. Before classifying errors under various headings,

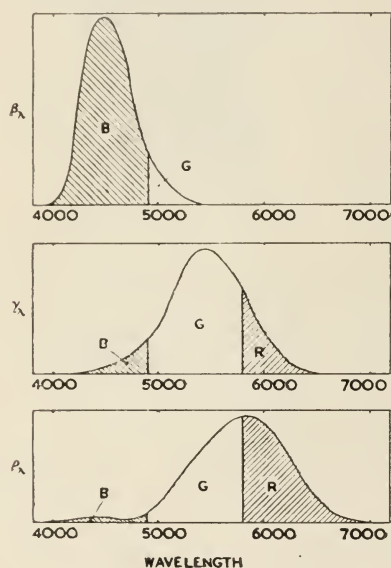


Fig. 3—The areas labelled R, G, and B show the magnitudes of the retinal responses controlled by the absorptions of the cyan, magenta, and yellow dyes respectively. In an ideal system the absorption of each dye would control one retinal response only.

however, and weighing their relative importance, the way in which colour rendering is judged must be considered for a moment.

Mental Comparisons

Colour photographs are practically never compared side by side with the original scene. Moreover, very few colour photographs are taken with a view to their being seen only by persons who were present at the time of exposure. So the majority of the criticisms of a colour photograph come from persons who

never saw the original scene, and whose judgment must be based on some mental comparison between what the picture looks like and what they think it *ought* to have looked like. The precision of such mental comparisons will depend entirely on the precision of the mental standard used. For instance, if in a colour photograph there was depicted, amongst other things, a pillar-box, then its colour would be mentally compared with one's impression of the usual colour of pillar-boxes. The impression will be the average of those given by a large number of different pillar-boxes seen on different occasions. And, of course, the colour sensations received will have been subject to the considerable variations caused by differences in the colour, intensity, and the direction of the lighting, whether the surface was wet or dry, dusty or clean, whether the pillar-box had been recently painted or not, etc. The impression, therefore, cannot be precise; and hence, provided that the reproduction of the pillar-box in the colour photograph compares favourably with what a pillar-box *could* look like, it will generally be acceptable.³

Similarly, all objects of well-known colour give rise to colour sensations which are not always the same and which exhibit quite wide variations. It is these variations, therefore, which govern the tolerances available in colour photography. Let us now consider some of these variations under the headings, lightness, saturation, and hue.

Variations of Lightness

Lightness is probably the attribute of surface colours which varies most from point to point over their surfaces. Any fabric tends to hang in folds, and the troughs will be much darker than the crests. Foliage, and grass, are subject to wide variations in lightness due to the shading of one leaf or blade by another, and due to the difference in orientation with respect to the direction of the incident light. Simultaneous contrast between a patch of colour and its background will also affect its apparent lightness. Thus a given colour will appear much lighter when seen against a black background than when seen against a white background. Thus one

would expect errors in lightness reproduction to be relatively unimportant in colour photography, and this is borne out by the fact that there is a considerable range of contrasts over which a colour photograph may vary without detriment.

Variations of Saturation

Saturation also exhibits variations from point to point over a surface, especially on any surface having some sheen or gloss. Such surfaces can also show large increases in saturation when the type of lighting is changed from diffuse to directional, and it is well known that a scene always looks more colourful when the sun is out than when the weather is overcast. The saturation of all colours of distant objects is likely to be decreased by atmospheric haze, and sometimes the effect is strong enough to remove all sensations of colour completely. Reference has already been made to the presence of dust or dirt on surfaces, and while this may result in some changes of lightness, the change in saturation will be considerable. Wetting a matte surface often results in startling increases in saturation. The saturation of the blueness of the sky varies enormously with the direction of viewing relative to the sun, and similar variations occur, of course, in the case of the blueness of seas, rivers and lakes. The apparent saturation of colours also varies with the intensity of the illumination; for instance, at dusk colours are far less saturated than at noon, and by moonlight colour vision has almost ceased, all colours appearing almost completely desaturated.

The use of illuminants of different colours, such as tungsten light and daylight, also results in variations in apparent colour,⁴ and in the case of blues and yellows the differences in saturation can be considerable. Similar effects also occur, of course, with different phases of daylight, such as noon sunlight, north sky light and late evening sunlight. Again simultaneous contrast can alter the apparent saturations of colours. A pale colour seen against its complementary colour appears more saturated than when against a saturated colour of the same hue. It would thus be expected that errors in satu-

ration would not be of very great importance. This is borne out by the appearance of many water-colour paintings, in which the colours are usually quite pale, but which as pictures are often highly successful. It seems that rather than requiring exact reproduction of saturation, all that is necessary is a reasonable saturation-maximum for each hue, and a uniform desaturation of colours of all hues and saturations, since this is what normally occurs in the conditions mentioned above. In terms of the purity characteristic curve, sug-

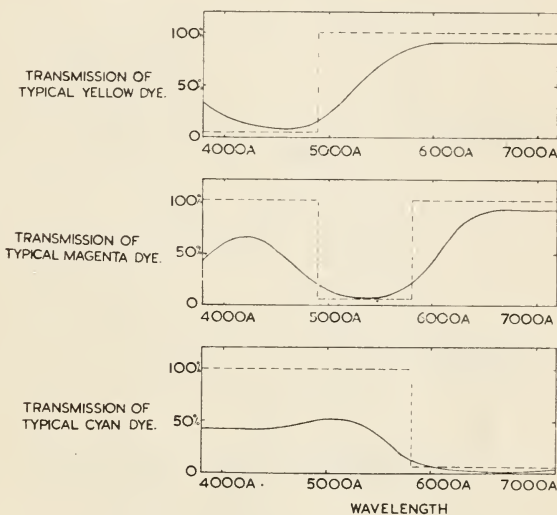


Fig. 4 — The spectral transmission curves of a cyan, a magenta, and a yellow dye, typical of those that have to be used in practice.

ested by Wright,⁵ this means that the purity gamma can have a value substantially below unity, but that it should have the same value for all hues, and that the curve should be linear with saturation.

Variations of Hue

Let hue as a variable in surface colours now be considered. Simultaneous contrast can cause apparent changes in the hues of colours, but it is clear that most of the phenomena described above, which give rise to changes in lightness and saturation, do not give rise to any changes in the hues of colours. The hues of some objects, however, are quite variable. For instance, foliage

varies in hue with time of year and with type of tree, and nearly all fruits change hue with degree of ripeness, as well as being different for different varieties. The colour of flesh varies with type of skin, and, of course, with amount of sunburn. There are, of course, other objects the hues of which vary, but, generally speaking, variations in hue, while important, would seem to be more restricted in surface colours than variations in lightness and saturation. It is, for instance, easier to think of a pillar-box which is a light or a

is the overall colour balance of the picture. If the picture is slightly off balance, pale colours will undergo violent changes of hue, and it is these which make off-balance pictures so intolerable.

It is concluded, therefore, that, owing to the way in which the colours in a photograph are judged, and owing to the large changes in colour which well-known objects so often undergo, the discrepancies inherent in present-day methods of colour photography can be tolerated. That is not to say, of course, that improvement⁶ is not desirable, and in certain types of process special devices have to be resorted to in order to overcome some of the discrepancies because they have exceeded the admittedly very wide tolerances.

COLOURED COUPLERS

For instance, when several copies of a colour film are needed, or when paper-prints are required, the most convenient method to use is that in which a colour-negative is made by the camera exposure, the required number of positive prints being printed subsequently on to films or paper, as the case may be. The colour negative is like an ordinary black-and-white negative in that whites are rendered as blacks, and blacks as whites, but in addition to the lightness of the colours being reversed the hues are also reversed; that is, they take on the hues of the complementary colours. These complementary colours are formed by means of three dyes, usually a cyan, a magenta, and a yellow dye of the type shown in Fig. 4. The colours in the final print are also formed by means of such a set of dyes, so that dyes are used twice in such a process. This means that the defects in the dyes take their toll on the colour reproduction twice, and the result often exceeds the tolerance. The particular faults which are most troublesome are the unwanted absorptions of the magenta dye in the blue region of the spectrum, and of the cyan dye in both the blue and the green regions. These unwanted absorptions cause large errors in lightness, saturation and hue, but the recent introduction of "coloured-couplers"⁷ can result in their being very effectively counteracted in the colour negative.

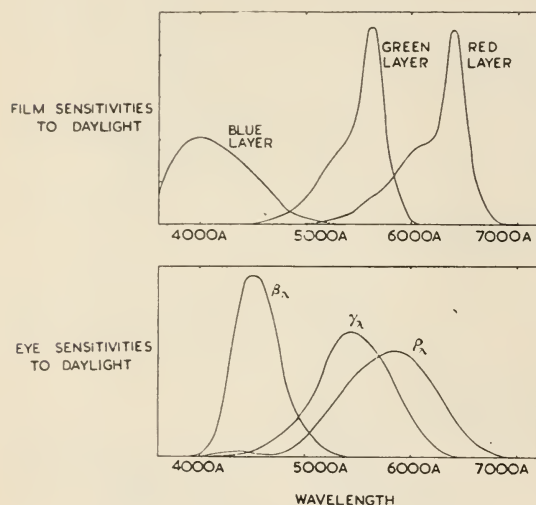


Fig. 5—Emulsion sensitivities typical of those used in three colour film, compared with the sensitivities of the eye.

dark red, or a pale or a deep red, than to think of one which is an orange- or magenta-red.

By this type of argument, and by experience, an approximate order of priority in the requirements, as far as colour is concerned, of a successful process of colour reproduction is arrived at, as follows:⁶

1. Correctness of hue.
2. Approximately equal desaturation of colours of all hues.
3. Approximately proportional desaturation of colours of all saturations.

By way of illustration of these principles it is a well-known fact that in colour reproduction the variable with the least tolerance

The principle on which coloured couplers work is shown diagrammatically in Fig. 6. Suppose that, in the colour negative, at its maximum concentration, m , the magenta dye, has red, green, and blue transmissions of 100%, 5%, and 50% respectively, as shown in Fig. 6 (a) by line A. It is assumed, for the sake of simplicity, that it is an ideal

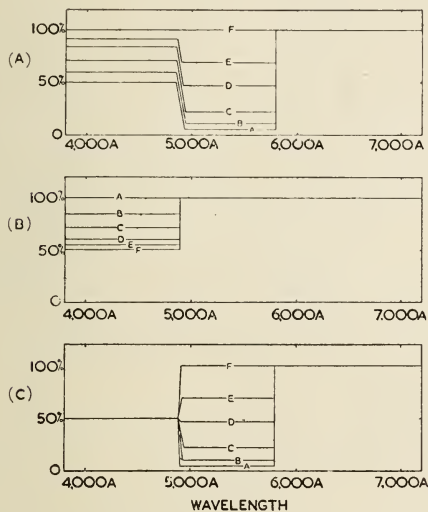


Fig. 6 — Diagrammatic representation of the way in which a magenta coloured coupler works.

- Transmission curves of magenta dye at different concentrations.
- Transmission curves of coloured couplers.
- Combined transmission curves of the dye and the coupler.

magenta dye except for a uniform unwanted absorption in the blue. The lines, B, C, D, E, and F, show what the absorptions would be at concentrations $(3/4)m$, $(1/2)m$, $(1/4)m$, $(1/8)m$, and zero, respectively. It will be supposed that this dye is formed by the colour-development of a magenta "coupler" in the green-sensitive layer of the emulsion. Let the concentration of the coupler before development be c . Then the concentrations of the coupler corresponding to the dye-concentrations A, B, C, D, E, and F will obviously be zero, $(1/4)c$, $(1/2)c$, $(3/4)c$, $(7/8)c$ and c respectively.

Suppose, now, that the coupler, instead of being colourless, was yellow, having red, green, and blue transmissions (at concentration c) of 100%, 100%, and 50%, respectively. As it is colour-developed to form the magenta dye, its yellow colour in the layer gradually becomes less and less, and its transmission curves for the same levels A, B,

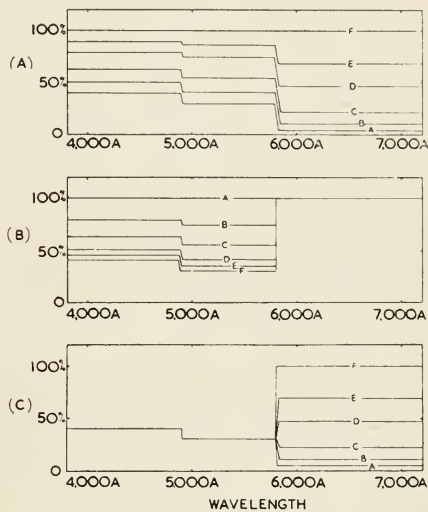


Fig. 7 — Diagrammatic representation of the way in which a cyan coloured coupler works.

- Transmission curves of cyan dye at different concentrations.
- Transmission curves of coloured coupler.
- Combined transmission curves of the dye and the coupler.

C, D, E, and F discussed above would be as shown in Fig. 6 (b). The full transmission curve for the layer, of course, is given by combining the appropriate pairs of curves from Figs. 6 (a) and (b) and these are shown in Fig. 6 (c). It is seen that the transmission in the blue region remains constant. When there is no magenta dye, the coupler alone has a transmission of 50%; when all the coupler has been used it no longer absorbs at all, but the magenta dye has a transmission of 50%. At all intermediate stages the blue transmission of the coupler multiplied by the

blue transmission of the magenta dye is also found to be equal to 50%.

Clearly, with this system, the effect of light on the green-sensitive layer results in variation in the green transmission of that layer, but has no effect on the values of the red and blue transmissions which are fixed at 100% and 50% respectively. The low value of the constant blue transmission can be easily compensated for, simply by increasing the blue content of the light used for printing by a factor of 2. Thus, the magenta-dye, with its yellow coupler, together form an arrangement by means of which only light in the green part of the spectrum is modulated. And hence, from the photographic point of view, the unwanted blue absorption of the magenta dye has been eliminated.

A pink-coupler, which forms a cyan-dye in the red sensitive layer, can similarly eliminate the effects of the unwanted green and blue absorptions of the dye. The way in which this takes place is shown in Fig. 7. In Fig. 7 (a), for the sake of simplicity, we have shown the transmission curves of a cyan dye which is ideal except for two uniform unwanted absorptions in the green and blue regions. The line A refers to the dye at maximum concentration, the red, green, and blue transmissions being 5%, 30%, and 40% respectively. The other lines are analogous with those of Fig. 6. Suppose that the coupler is of a pink colour, having, at maximum concentration, red, green, and blue transmissions of 100%, 30%, and 40% respectively, as shown in Fig. 7 (b); when this coupler is present with the cyan dye which it forms on colour development, the red sensitive layer will have the transmission curves shown in Fig. 7 (c) for the different concentrations. Again it is seen that, where there were varying unwanted absorptions, now they are constant. Hence, by increasing the green content of the printing light by a factor of $3\frac{1}{3}$ and that of the blue by a further factor of $2\frac{1}{2}$, the net result of the effect of light on the red-sensitive layer is merely to modulate the red-transmission of the layers.

Of course, when actual dyes and coloured couplers are used the transmissions shown as constant in Figs. 6 (c) and 7 (c) are only

approximately constant, but this scarcely impairs the degree of improvement resulting. In fact, by allowing these transmissions to rise, by using couplers of deeper colours, the unwanted absorptions of the cyan and magenta dyes used in the print can also be, to some extent, compensated for.

CONCLUSION

There is little doubt that the introduction of these coloured couplers in colour photography is a major step forward in its technological development, and it may eventually result in the widespread use of colour negatives for the production of professional motion pictures in colour. One of the main attractions of the use of colour-negative stock is that it can be used in an ordinary cine-camera. This is also true, however, of the multilayer stripping negative films recently described,⁸ and, in the future, the colour-negative (with coloured couplers) and the stripping-negative may be strong rivals for camera use.

Either type of negative can be used for making prints by any of the well-known methods, and the three that seem likely to gain most attention in the future are the dye-imbibition process, direct printing on to three-layer colour positive stock, and printing on to lenticular stock.²

Whichever combination of negative and positive methods is used it will remain true that, fundamentally, the success of all modern methods of colour cinematography is due very largely to the wide visual tolerances with which we are fortunate enough to have to deal.

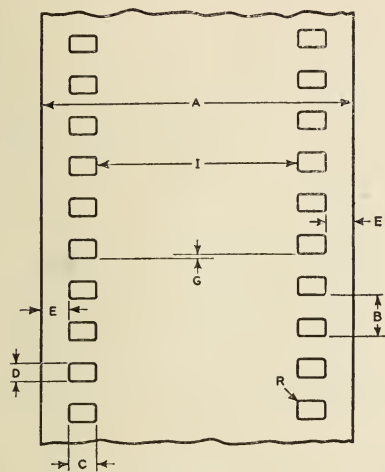
Most of the effects described in the paper were demonstrated during the lecture, either by actual experiments or by means of colour transparencies.

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1. See, for example, W. D. Wright, "Researches on Normal and Defective Colour Vision," Kimpton, London, 1946.
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PROPOSED AMERICAN STANDARD

Cutting and Perforating Dimensions for 35mm. Motion Picture Film-Alternate Standards for either Positive or Negative Raw Stock



Dimensions	Inches	Millimeters
A	1.377 ± 0.001	34.980 ± 0.025
B	0.1870 ± 0.0005	4.750 ± 0.013
C	0.1100 ± 0.0004	2.794 ± 0.01
D	0.0730 ± 0.0004	1.85 ± 0.01
E	0.079 ± 0.002	2.01 ± 0.05
G	Not > 0.001	Not > 0.025
I	0.999 ± 0.002	25.37 ± 0.05
L*	18.700 ± 0.015	474.98 ± 0.38
R	0.013 ± 0.001	0.330 ± 0.025

These dimensions and tolerances apply to the material immediately after cutting and perforating.

* This dimension represents the length of any 100 consecutive perforation intervals.

APPENDIX

The dimensions given in this standard represent the practice of film manufacturers in that the dimensions and tolerances are for film immediately after perforation. The punches and dies themselves are made to tolerances considerably smaller than those given, but owing to the fact that film is a plastic material, the dimensions of the slit and perforated film never agree exactly with the dimensions of the punches and dies. Shrinkage of the film, due to change in moisture content or loss of residual solvents, invariably results in a change in these dimensions during the life of the film. This change is generally uniform throughout the roll.

The uniformity of perforation is one of the most important of the variables affecting steadiness of projection.

Variations in pitch from roll to roll are of little significance compared to variations from one sprocket hole to the next. Actually, it is the maximum variation from one sprocket

hole to the next within any small group that is important.

Perforations of this size and shape were first described in the Journal of the S.M.P.E. in 1932 by Dubray and Howell. In 1937, a Subcommittee report reviewed the work to date. The main interest in the perforation at that time was in its use as a universal perforation for both positive and negative film. The perforation has been adopted as a standard at this time largely because it has a projection life comparable to that of the perforation used for ordinary cine positive film (American Standard Z22.36—1947), and the same over-all dimensions as the perforations used in the negative film (American Standard Z22.34—1949). It should be particularly noted that although the present standard has the same over-all dimensions as the older cine negative perforation, positioning pins or sprocket teeth made to fit this perforation exactly will injure the corners of the cine negative perforation.

THE COUNCIL

Summary of the meeting held on Wednesday, November 7th, 1951, at 117, Piccadilly, W. 1

Present : Mr. H. S. Hind (*Deputy Vice-President*) in the Chair, and Messrs. A. W. Watkins (*Past President*), R. J. T. Brown (*Hon. Secretary*), N. Leavers (*Hon. Treasurer*), F. G. Gunn, F. S. Hawkins, T. W. Howard, E. Oram and R. E. Pulman.

In attendance : Miss J. Poynton (*Secretary*).

Apologies for Absence : Apologies for absence were received from the President and the Vice-President.

Death of an Hon. Fellow : The sudden death of Mr. William Barker has been received with profound sorrow, and the Council has conveyed a message of the deepest sympathy to Mrs. Barker and her family.

Tele-Kine Group.—Mr. R. E. Pulman is appointed Deputy Chairman of the Co-ordinating Committee.

A Course on Television in the Kinema has been arranged to take place in 1952. Owing to the large number of applications, the first commences on January 18 and the second on February 22.

One hundred and fifty of the C.M.A.'s chief projectionists are enrolling in the courses, which will consist of four lectures each and which will take place at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, W.C.2.

COMMITTEE REPORTS

Education Committee.—The Course on Kine Camera Technique commenced on October 15 at Ealing Studios. A full complement of students has been enrolled.

The Course on Sensitometry will commence at the Colonial Film Unit, 21, Soho Square, W.1, on January 21, 1952.—*Report received and adopted.*

Membership Committee.—The following are elected:—

Alan E. White (Member), G.B. Screen Services, Film House, Wardour Street, W.1.

James Leslie Stuart (Member), Geo. Humphries & Co. Ltd., 71/77, Whitfield Street, W.1.

Iqbal Hasan Shahzad (Student), British Acoustic Films Ltd., Woodger Road, W.12.

Donald William Davis (Associate), Ilford Ltd., Selo Works, Brentwood, Essex.

Alec Tutchings (Member), Telecommunications Research Establishment, Malvern, Worcs.

Dudley Francis Newstead (Member), A. Kershaw & Sons, Harehills Lane, Leeds, 8.

Victor Charles St. Locke (Member), Commercial-Educational Ltd., 20/24, Red Lion Court, E.C.4.

George Ivan Barnett (Member), G.I.B. Films (Hastings) Ltd., 44, Eversfield Place, St. Leonards, Sussex.

Allan John Ockenden (Associate), Olympic Kinematograph Laboratories, School Road, N.W.10.

Michael John Harmer (Student), Ritz Cinema, Hastings, Sussex.

The resignations of one Member and two Students, and the death of one Member are noted with regret.—*Report received and adopted.*

16mm. Film Division.—The Chairmen of the Investigation Technical Sub-Committees submitted progress reports. The following *Ad Hoc* Committee is appointed to investigate the opportunity which exists for keeping abreast of the technicalities of 16 mm. film production and to make recommendations: Messrs. C. B. Watkinson (Chairman), P. W. Dennis and G. H. Sewell.—*Report received and adopted.*

The proceedings then terminated.

117 PICCADILLY

The Society's offices must be vacated at 31st March, 1952. The Secretary will be glad to hear of possible alternative accommodation. (Approx. 500 sq. feet.)

PERSONAL ANNOUNCEMENT

Owing to an increasing demand it has been found possible to reduce the price of the Kelly 35 mm. Cine Calculator from 25s. to 17s. 6d.

They can be obtained from the Secretary, British Society of Cinematographers, 59, Sloane Street, London, W.1, at the revised price, plus 6d. postage in U.K., as from November 1, 1951.

11581

